VOLUME II

DOCUMENT NUMBER

QTR-2191-001

REV. N/C

TITLE

QUALIFICATION TEST REPORT FOR 450 GALLON CRASHWORTHY FUEL TANK FOR U.S. AIR FORCE H-53 HELICOPTER

TEST PERFORMED BY

FIBER SCIENCE DIVISION

CONTRACT NUMBER

F09603-79-C-1642-P20002

PREPARED BY

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APRIL 2, 1982

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PREPARED FOR

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ROBINS AIR FORCE BASE, GEORGIA 31098

APPENDIX A

QUALIFICATION TEST PROCEDURES

QTR-2191

SECTIONS A-THRU J

DOCUMENT NUMBER

QTP-2191 SECTION "A"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR INDIVIDUAL INSPECTION

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 12/1/80

CHECKED BY: Randy Stone DATE: 12-9-80

APPROVED BY: C. A. Patrick Jr DATE: 12-9-80

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "A"

DATE: 12/1/80

1.0 SCOPE

This procedure covers the requirements for Individual Inspection of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-F-8615	General Specification for fuel system components
MIL-C-45664	Calibration System Requirements
MIL-STD-831	Test Reports, Preparation of.

2.2 FEDERAL SPECIFICATION

Fed. Test Method Std.	141 Methods for testing of paints, varnish, lacquer and related materials.

2.3 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.4 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel Tank.

3.0 REQUIREMENTS

3.1 INSPECTION ARTICLE

Four (4) tank assemblies(2191-001) equipped with a Government furnished pylon (27-450-4400) shall be subjected to the individual inspection requirements of Paragraph 4.4.1 as described in Technical Exhibit ASD/ENFEA-78.

3.2 INDIVIDUAL INSPECTION METHOD

The following individual inspections are to be performed during and after the tank fabrication process by the Quality Assurance Department.

3.2.1 INTERNAL CLEANLINESS INSPECTION

Each internal component shall be thoroughly inspected for cleanliness relative to dirt, sand, metal or plastic chips or other foreign matter while being assembled and after final assembly. Each tank shall be judged by a visual examination by wiping all accessible suspect areas with a clean white lint-free cloth. This examination shall be made before the liner receives its final access bond before winding, and again before tank is closed for functional test.

3.2.2 LINER PROOF PRESSURE INSPECTION

Eash liner shall contain without leakage an internal proof pressure of 2.0 psi for five (5) minutes.

3.2.3 LINER DIAMETER INSPECTION

Each tank liner while pressurized to the liner design pressure per Paragraph 3.2.2 shall be measured at four (4) locations as shown in Figure 1 to verify the compliance with the tank liner sub assembly drawing (2191-005).

3.2.4 COMPOSITE CONSTRUCTION INSPECTION

Each pre production tank shall be inspected during contruction and at final assembly for the following requirements to the paragraphs indicated in Technical Exhibit ASD/ENFEA-78 and illustrated in Figure 2.

3.2.4.1 FILAMENT WINDING EQUIPMENT

To have repeatable helical and circumferential capabilities per Paragraph 3.5.3.1.

3.2.4.2 ROVING DEGRADATION

To have tensioned roving path that shall traverse no corner unpolished or less than .25 inch radius per Paragraph 3.5.3.1.1

3.2.4.3 ROVING GAP

Maximum roving gap between adjoining rovings not to exceed .25 inches per Paragraph 3.5.3.1.2.

3.2.4.4 ROVING BRIDGING

Maximum roving bridging not to exceed .50 inch wide by 12 inches long and must be filled per Paragraph 3.5.3.1.3.

3.2.4.5 ROVING SLIPPAGE

Maximum roving slippage to achieve natural geodesic path not to exceed .25 inches per Paragraph 3.5.3.1.4.

3.2.4.6 ROVING KNOTS

Roving knots must be removed and rovings overlapped end to end by 2.0 inches minimum per Paragraph 3.5.3.1.5.

3.2.4.7 ROVING RESIN CONTROL

Roving must be thoroughly impregnated with resin per Paragraph 3.5.3.1.6.

3.2.4.8 UNIFORM COMPOSITE CONSTRUCTION

Uniform structural composite construction shall be maintained from tank to tank per Paragraph 3.5.3.1.7.

3.2.5 COMPOSITE CONSTRUCTION TESTING

Composite materials testing shall be conducted on samples of the filament wound composite to the following requirements to the paragraphs indicated in Technical Exhibit ASD/ENFEA-78.

3.2.5.1 RESIN CONTENT

Resin content of actual filament wound sample part from each pre-production tank shall not vary more than ± 5% of design value per Paragraph 4.6.7.4.1.

3.2.5.2 LAP SHEAR TESTING

Six (6) samples of actual filament wound materials shall be bonded to actual tank liner scrap material as shown in Figure 3. Each sample shall then be cured and lap shear tested to not less than the design values per paragraph 4.6.7.4.2.

3.2.5.3 COMPOSITE SANDWICH CORE

Composite sandwich core shall be Nomex Honeycomb having a minimum compressive strength of 250 psi per Paragraph 3.3.2.4.1.

3.2.5.4 STRUCTURAL COMPOSITE CURING

Structural composite curing shall be in an automatically controlled oven with continuous temperature recorder data sheet for each tank per Paragraph 4.6.7.6.

3.3 INSPECTION EQUIPMENT

The inspection equipment required to verify compliance of all assemblies, parts, and materials covered by this procedure shall be of good commercial quality in proper working condition, regularly calibrated and under strict equipment control by the Quality Assurance Department.

3.3.1 INSPECTION EQUIPMENT CALIBRATION

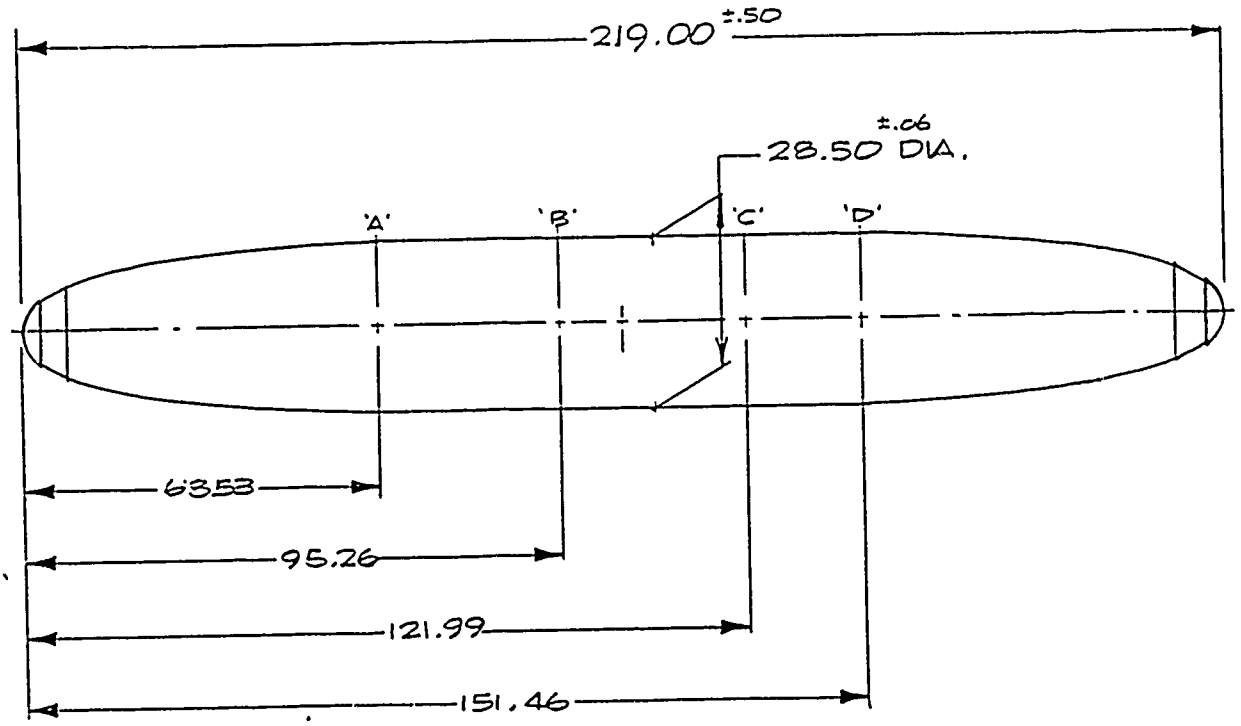
All inspection equipment shall be calibrated and capable of reading or recording data within ± 2% of its full scale value. No inspection equipment shall be used that has not been calibrated within the previous calibration period. Calibration shall be per MIL-C-45662.

3.4 INSPECTION PROCEDURES

The inspection procedures shall be in accordance with Paragraph 4 of this document.

3.5 DOCUMENTATION

At the conclusion of these inspection tests, an inspection test report will be prepared for submission to the contractor.

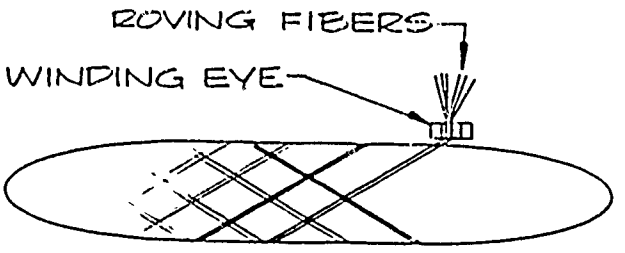


ASSEMBLED TANK

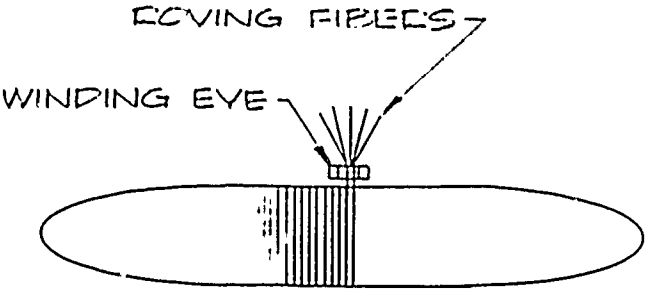
LINER WITH POLAR END CAPS

FIGURE 1

LINER DIAMETER INSPECTION

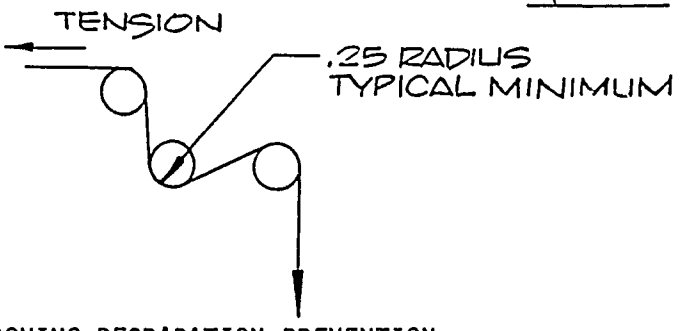


REPEATABLE HELICAL
WINDING PATTERN

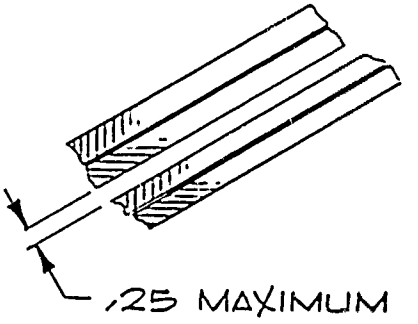


CONSTANT LEAD
CIRCUMFERENTIAL WINDING

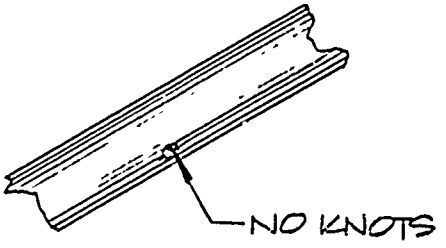
FILAMENT WINDING
EQUIPMENT



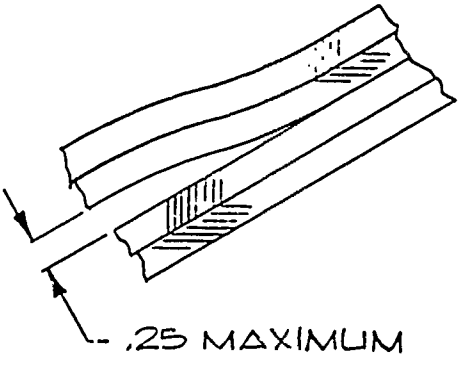
ROVING DEGRADATION PREVENTION



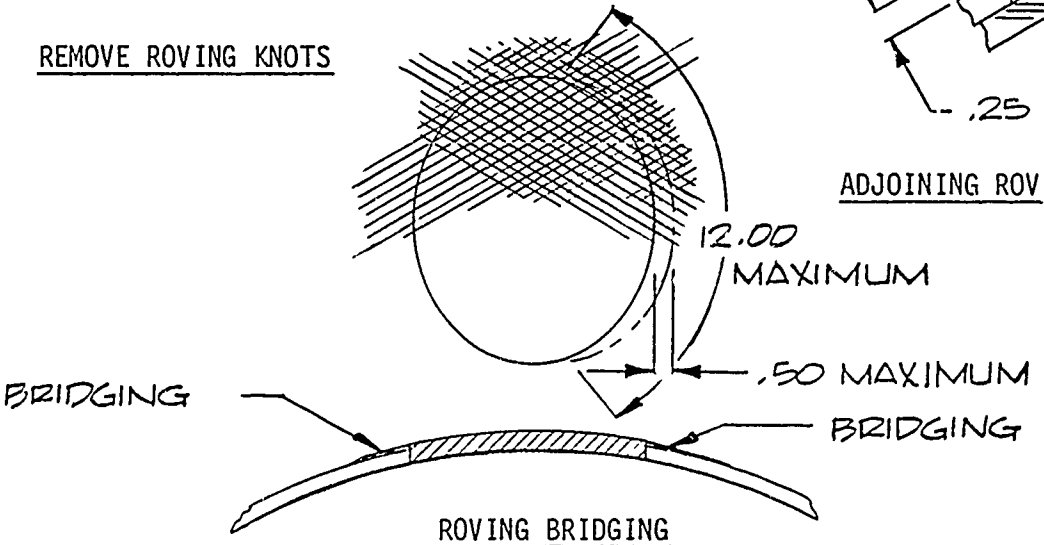
ADJOINING ROVING WINDING GAP



REMOVE ROVING KNOTS



ADJOINING ROVING SLIPAGE GAP



ROVING BRIDGING

FIGURE 2 - COMPOSITE CONSTRUCTION CRITERIA

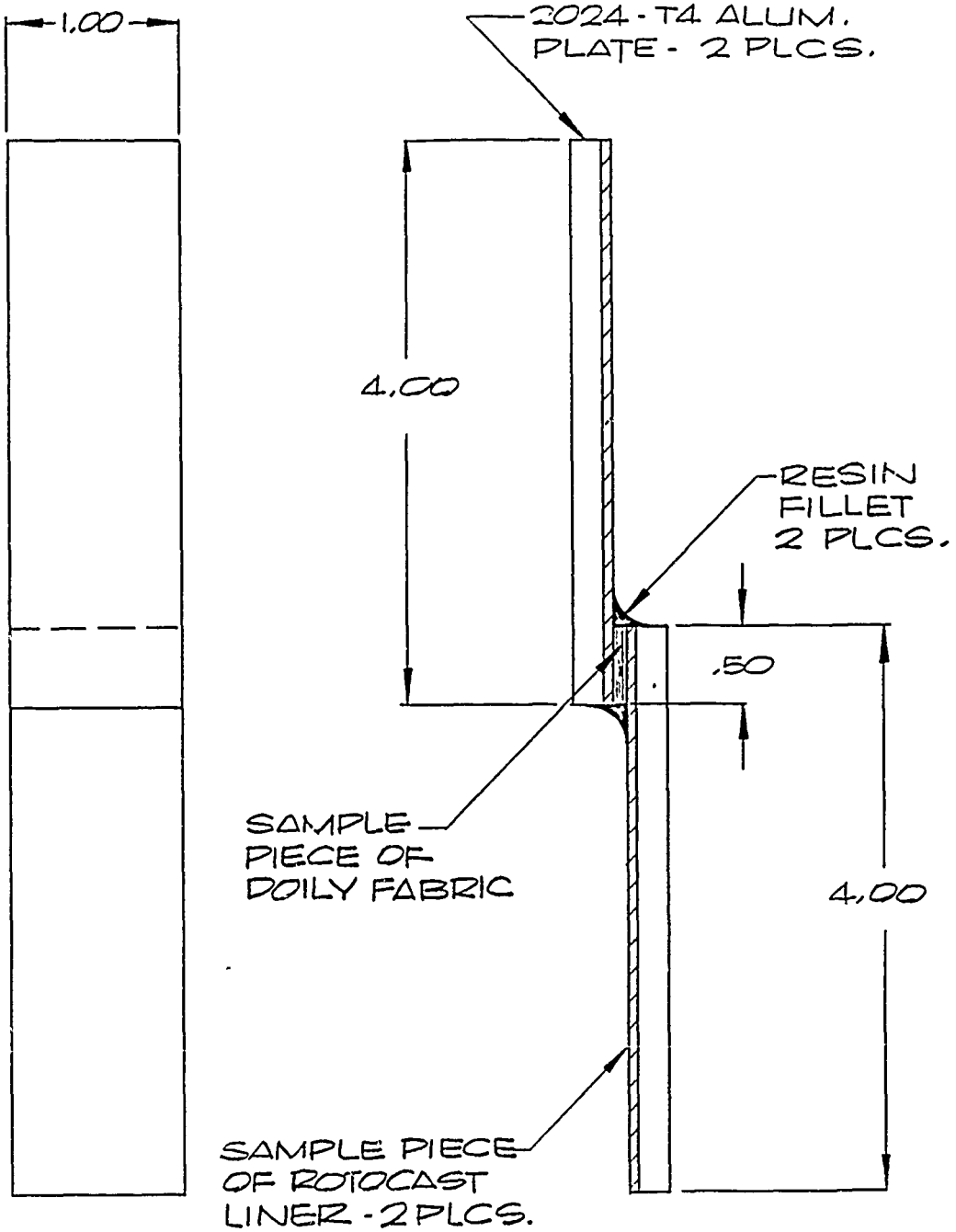


FIGURE 3

LAP SHEAR TEST SAMPLE ARRANGEMENT

4.0 QUALIFICATION INSPECTION PROCEDURES

4.1 INSPECTION EQUIPMENT REVIEW

All inspection equipment to be used for this procedure shall be examined for accuracy relative to the task assigned, be in good working condition and to possess documentation showing equipment to have been regularly calibrated.

4.1.1 INSPECTION EQUIPMENT CALIBRATION

All inspection equipment shall be inspected to verify that each piece of equipment has had a calibration check within the last calibration period.

4.2 INDIVIDUAL INSPECTION

Perform the following individual inspections during and after the tank fabrication.

4.2.1 INTERNAL CLEANLINESS INSPECTION

Wipe with a lint-free cloth before closing liner assembly and again before closing final assembly the internal surface of tank and all fittings to check for dirt, sand, metallic or plastic chips or other foreign material. The internal surface and fittings of the tank shall be clean.

4.2.2 LINER PROOF PRESSURE

Inflate li ˙ to 2.0 psi and soap bubble check for leakage before wind ˙g.

4.2.3 LINER DIAMETER INSPECTION

Inflate liner to the liner design pressure and measure tank at the locations shown in Figure 1. All diameters must meet the requirement of 28.50 ± .06 dia. when measured with a pi tape.

4.2.4 COMPOSITE CONSTRUCTION INSPECTION

Perform the following inspections relative to the composite construction:

4.2.4.1 FILAMENT WINDING EQUIPMENT

Verify that the filament winding equipment when properly programmed can wind repeatable helical and circumferential winding to the engineering design requirements.

4.2.4.2 ROVING DEGRADATION

Verify that the roving does not pass over any unpolished corner radius less than .25 inches.

4.2.4.3 ROVING GAP

Verify that during the entire winding operation no roving gap between adjoining roving exceeds .25 inches.

4.2.4.4 ROVING BRIDGING

Verify that no bridging of roving over a core splice or core and core reinforcement insertion or over an inverted surface shall exceed .50 inches wide by 12 inches long. All bridging must be filled before assembly is complete.

4.2.4.5 ROVING SLIPPAGE

Verify that during the entire winding operation no roving slippage shall exist to achieve a more natural geodesic path than .25 inches.

4.2.4.6 ROVING KNOTS

Verify that no roving knots exist that have not been removed with broken rovings being overlayed by 2.00 ± .50 inch.

4.2.4.7 ROVING RESIN CONTROL

Verify that all rovings are or will be thoroughly impregnated before tank is thoroughly cured.

Note: Care should also be taken to prevent excess resin from accumulating before tank is thoroughly cured.

4.2.4.8 UNIFORM COMPOSITE CONSTRUCTION

Verify uniform composite construction by compliance of the fabrication process with the manufacturing process sheets and the compliance of the wound assembly weight with engineering design weight.

4.2.5 COMPOSITE CONSTRUCTION TESTING

Perform the following composite construction testing on samples of the actual materials used in the filament winding process.

4.2.5.1 RESIN CONTENT

Verify the filament winding resin content by weighing equal lengths (approximately 50 feet) of an unimpregnated band width of roving and an impregnated band width of roving that has passed through the impregnation system in the same manner and resin as the actual tank. (It is recommended that this test sample be removed at the end of the winding process for the inside layer of the sandwich wall construction.) The resin content shall by volume be 50% $\pm$ 5%.

4.2.5.2 LAP SHEAR TESTING

Verify the bond between the liner and the filament wound roving by performing lap shear testing per ASTM-D-1002 method 64. Six (6) specimens shall be prepared as shown in Figure 3. A minimum lap shear strength of 200 psi must be achieved.

4.2.5.3 COMPOSITE SANDWICH CORE

Verify that composite sandwich core material has a minimum compressive strength of 250 psi either by actual test of a sample of the actual material to be used or by certified test to this requirement from the material supplier.

4.2.5.4 STRUCTURAL COMPOSITE CURING

Verify that each tank has been cured in a regularly certified oven to the engineering design requirements. The cure cycle shall be continuously recorded and a permanent record kept for each tank.

5.0 QUALIFICATION INSPECTION REPORT

A formal qualification inspection test report shall be submitted per MIL-STD-831 within 30 days after the inspection testing is complete. This report is to include copies of all measurements, individual test reports, temperature recorder data sheets and manufacturing process sheets used in actual manufacture of tank. Each test tank shall be retained for further testing.

APPENDIX "A"

INSPECTION TEST DATA SHEETS

INSPECTION TEST DATA SHEET

QTR-2191 SECTION "A"

Inspection Activity _____ Activity Quality Engr. _____

Tank Serial No. _____ F.S.I. Test Engr. _____

Inspection Date _____ Government Rep. _____

INSPECTION EQUIPMENT REVIEW

Ref. Para. 4.1 List of inspection equipment used to verify the requirements of this procedure. List working condition, verify if equipment has been regularly calibrated and last calibration date.

ITEM	WORKING CONDITION	REGULARLY CALIBRATED	LAST CALIBRATION DATE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			

INDIVIDUAL INSPECTION

Ref. Para. 4.2: Individual Inspections performed

By _____ Date _____

INTERNAL CLEANLINESS INSPECTION

Ref. Para 4.2.1: LINT-FREE CLOTH WIPE INSPECTION

ITEM	REMARKS	INSPECTION STAMP
Liner		
Frames		
Tubing		
Bellmouth		
Others:		
1.		
2.		
3.		
4.		

INSPECT LINER FOR LEAKAGE

Ref. Para 4.2.2: LINER PROOF PRESSURE

ITEM	REMARKS	INSPECTION STAMP
2.0 ± .25 psi		
Soap Bubble Test		
Leaks (If any)		

LOCATION	REMARKS	INSPECTION STAMP
1.		
2.		
3.		
4.		

LINER DIAMETER INSPECTION

Ref. Para. 4.2.3: LINER MEASURED TO THE REQUIREMENTS OF FIGURE 1

LOCATION	DIAMETER	INSPECTION STAMP
A.		
B.		
C.		
D.		

COMPOSITE CONSTRUCTION INSPECTION

Ref. Para. 4.2.4: Composite Construction Inspection performed

By _____ Date _____

FILAMENT WINDING EQUIPMENT

Ref. Para. 4.2.4.1: INSPECT EQUIPMENT CAPABILITIES

ITEM	REMARKS	INSP. STAMP
Circumferential Capabilities		
Helical Capabilities		
Machine Program		

ROVING DEGRATION

Ref. Para. 4.2.4.2:

ITEM	REMARKS	INSP. STAMP
Fiber Creel		
Resin Bath		
Spreader Bar		
Winding Eye		
Guide Eyes (If Applicable)		
Direction Control Bars (If Applicable)		

ROVING GAP

Ref. Para. 4.2.4.3: SHALL NOT EXCEED .25 INCHES

LOCATION	REMARKS	INSP. STAMP
1.		
2.		
3.		
4.		

ROVING BRIDGING

Ref. Para. 4.2.4.4: SHALL NOT EXCEED .50 INCHES BY 12.00 INCHES

	LOCATION	REMARKS	INSP. STAMP
1.			
2.			
3.			
4.			

ROVING SLIPPAGE

Ref. Para. 4.2.4.5: SHALL NOT EXCEED .25 INCHES

	LOCATION	REMARKS	INSP. STAMP
1.			
2.			
3.			
4.			

ROVING KNOTS

Ref. Para. 4.2.4.6: SHALL NOT EXIST WITHOUT REMOVAL

	LOCATION	REMARKS	INSP. STAMP
1.			
2.			
3.			
4.			

ROVING RESIN CONTROL

Ref. Para. 4.2.4.7: VERIFY COMPLETE INPREGNATION

REMARKS: _____

_____

_____

_____

INSPECTION STAMP: _____

UNIFORM COMPOSITE CONSTRUCTION

Ref. Para. 4.2.4.8: VERIFY MANUFACTURING PROCESS IN COMPLIANCE WITH ENGINEERING REQUIREMENTS, INCLUDING WEIGHT

ITEM	REMARKS	INSP. STAMP
Liner Weight		
Manufacturing		
Process Compliance		
Cured Assembly Weight		

COMPOSITE CONSTRUCTION TESTING

Ref. Para. 4.2.5: Composite Construction Testing performed

By _____ Date _____

RESIN CONTENT

REF: Para 4.2.5.1 — Verify resin content of approximately 50 feet of impregnated roving. Shall be 50% ± 5% by volume.

ITEM	LENGTH	WEIGHT
Dry S-2 Glass Roving	_____	_____
Impregnated Roving	_____	_____

Calculated Resin Content _____

Remarks: _____

_____

_____

_____

LAP SHEAR TESTING

REF: Para. 4.2.5.2 — Prepare Lap Shear per Figure 3.

NOTE: Test method per ASTM-D-1002 method 64 (minimum value 200 psi)

SAMPLE	CURE TEMP.	CURE TIME	TEST VALUE
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____

COMPOSITE SANDWICH CORE

REF: Para 4.2.5.3

Verify 250 psi compressive strength.

NOTE: Either a or b must comply.

a. Certified vendor test.

Remarks: _____

_____

_____

_____

b. Lab test of 5 samples from each batch or lot each from a different sheet in the batch.

Item	Tested Compressive Strength
1	_____
2	_____
3	_____
4	_____
5	_____
6	_____

STRUCTURAL COMPOSITE CURING

REF: Para 4.2.5.4 Verify proper cure cycle to design requirements.

CURE TEMPERATURE

Design Requirements	Actual Values
Stage 1 _____	_____
Stage 2 _____	_____
Stage 3 _____	_____
Stage 4 _____	_____

TIME AT TEMPERATURE

Design Requirements	Actual Values
Stage 1 _____	_____
Stage 2 _____	_____
Stage 3 _____	_____
Stage 4 _____	_____

NOTE: If temperature recorder was used, attach a copy of recorder sheet.

EVALUATION OF DATA

TANK LINER FABRICATION: _____

FILAMENT WINDING OF TANK: _____

TANK COMPOSITE CURING: _____

EXAMINATION OF CURED: _____

DOCUMENT NUMBER

QTP-2191 SECTION "B"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR PRODUCT EXAMINATION

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 1/14/81

CHECKED BY: Randy F. Stone DATE: 3/31/81

APPROVED BY: C. G. Patmore Jr. DATE: 3/31/81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "B"

DATE: 1/14/81

1.0 SCOPE

This procedure covers the requirements for Product Examination of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-P-38477	Plastic material, pressure sensitive, for aircraft identification marking.
MIL-C-45664	Calibration System Requirements
MIL-STD-831	Test Reports, Preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.3 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel tank.

2.4 QUALIFICATION TEST PROCEDURES

QTP-2191 Section "A"	Requirements for individual inspection.
QTP-2191 Section "M"	Requirements for maintainability

3.0 REQUIREMENTS

3.1 PRODUCT EXAMINATION ARTICLE

Four (4) tank assemblies (2191-001) equipped with a Government furnished pylon (27-450-4400) shall be subjected to the product examination requirements of Paragraph 4.6.1 as described in Technical Exhibit ASD/ENFEA-78.

3.2 PRODUCT EXAMINATION METHOD

The following examinations are to be performed after completion of the tank fabrication process and final assembly by the Quality Assurance Department.

3.2.1 DESIGN CONFORMANCE

Each tank shall be inspected for conformance to the design drawings, construction, materials and workmanship, exterior surface finish, marking and interchangeability.

3.2.1.1 DESIGN DRAWINGS

Each tank assembly shall be inspected for conformance to the correct revision of the tank installation drawing 2191-001.

3.2.1.2 CONSTRUCTION

Each tank shall be examined to verify that the tank was constructed in accordance with the manufacturing job card and complies with Paragraphs 3.2.4 and 3.2.5 of the Qualification Test Procedures QTP-2191 Section "A".

3.2.1.3 MATERIALS

Each tank shall be examined to verify that the materials used to manufacture the tank are in accordance with the applicable drawings and specifications.

3.2.1.4 WORKMANSHIP

Each tank shall be examined to verify that the workmanship is of a quality commensurate with good composite filament wound practices and complies with Paragraphs 3.2.4.3 to 3.2.4.6 of the Qualification Test Procedures QTP-2191 Section "A".

3.2.1.5 EXTERIOR SURFACE FINISH

Each tank shall be examined to verify that the exterior surfact finish meet or exceeds the requirements of Paragraph 4.6.1.1 of the Technical Exhibit ASD/ENFEA-78.

3.2.1.6 EXTERIOR MARKINGS

Each tank shall be examined to verify that the exterior marking including decals comply with the requirements of the 450 gallon H-53 tank installation Drawing 2191-001. The identification decal shall be per MIL-P-38477. The location of the identification decal and the information required thereon shall be per Paragraph 3.10.2 of the Technical Exhibit ASD/ENFEA-78.

3.2.1.7 INTERCHANGEABILITY

Each tank shall be examined with a master gage to verify its interchangeability with the 450 gallon fuel tank pylon assembly 27-450-4400-__. All other interchangeable parts shall be examined by individual inspection or by use of Master Go-Nogo gages, and demonstrated to be interchangeable as part of the maintainability qualification test procedure QTP-2191 Section "I".

3.3 INSPECTION EQUIPMENT

The inspection equipment required to verify compliance of all assemblies, parts, and materials covered by this procedure shall be of good commercial quality in proper working condition, regularly calibrated and under strict equipment control by the Quality Assurance Department.

3.3.1 INSPECTION EQUIPMENT CALIBRATION

All inspection equipment shall be calibrated and capable of reading or recording data within ± 2% of its full scale value. No inspection equipment shall be used that has not been calibrated within the previous calibration period. Calibration shall be per MIL-C-45662.

3.4 INSPECTION PROCEDURES

The inspection procedures shall be in accordance with Paragraph 4 of this document.

3.5 DOCUMENTATION

At the conclusion of these examination inspection tests, an inspection test report will be prepared for submission to Fiber Science Engineering.

4.0 PRODUCT EXAMINATION QUALIFICATION PRODECURES

4.1 EXAMINATION EQUIPMENT REVIEW

All inspection equipment to be used for this examination shall be reviewed for accuracy relative to the task assigned, be in good working condition and to possess documentation showing equipment to have been regularly calibrated.

4.1.1 PRODUCT EXAMINATION EQUIPMENT CALIBRATION

All examination inspection equipment shall be inspected to verify that each piece of equipment has had a calibration check within the last calibration period.

4.2 SUBMISSION FOR EXAMINATION

Verify that each tank submitted for examination of product inspection has completed all operations on the job card, has completed the qualification test procedure for individual inspection and that the appendix data sheets have been filled out and where applicable, approved by an assigned authorized signature.

4.2.1 EXAMINATION OF PRODUCT

Each tank submitted for examination shall be examined to the following design conformance criteria:

4.2.1.1 DESIGN DRAWINGS

Verify that the tank conforms to the latest revision of 2191-001 and any sub assembly drawings or detail drawings that have not received previous conformance inspection.

4.2.1.2 CONSTRUCTION

Verify that the tank was constructed in accordance with the manufacturing job card and complies with Paragraphs 3.2.4 and 3.2.5 of the Qualification Test Procedure QTP-2191 Section "A".

4.2.1.3 MATERIALS

Verify either by vendor certification or actual test that the tank was constructed from materials in accordance with the applicable drawings and specifications.

4.2.1.4 WORKMANSHIP

Verify that the quality of workmanship on the tank is commensurate with the requirements of Paragraph 3.2.1.4.

4.2.1.5 EXTERIOR SURFACE FINISH

Examine and verify that the exterior surface finish is in accordance with Paragraph 4.6.1.1 of the Technical Exhibit ASD/ENFEA-78.

4.2.1.6 EXTERIOR MARKINGS

Verify that the exterior markings on the tank including the decal conform to the requirements of Paragraph 3.2.1.6.

4.2.1.7 INTERCHANGEABILITY

Verify the interchangeability of all removable and replaceable parts per Paragraph 3.2.1.7. The interchangeability of the mounting holes for the pylon shall be verified with the master gage.

5.0 QUALIFICATION EXAMINATION REPORT

A formal qualification examination test report shall be submitted per MIL-STD-831 within 30 days after the examination of the product is complete. This report is to include copies of all examinations made and measurements taken. Each test tank shall be retained for further testing.

APPENDIX "A"

PRODUCT EXAMINATION DATA SHEETS

ROUCT EXAMINATION DATA SHEET

QTR-2191 SECTION "B"

Inspection Activity _____ Activity Quality Engr. _____

Tank Serial No. _____ F. S. I. Test Engr. _____

Inspection Date _____ Government Rep. _____

PRODUCT EXAMINATION EQUIPMENT REVIEW

Ref. Para. 4.1 List of examination inspection equipment used to verify the requirements of this procedure. List working condition, verify if equipment has been regularly calibrated and last calibration date.

ITEM	WORKING CONDITION	REGULARLY CALIBRATED	LAST CALIBRATION DATE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

SUBMISSION FOR EXAMINATION

Ref. Para. 4.2 VERIFY COMPLETION OF FOLLOWING:

Completion of all Operations on Job Card through Final Assembly.

REMARKS: _____

_____

_____

_____

_____

_____

_____

Verified By _____ Date _____

Completion of Individual Inspection Requirements of QTP-2191 Section "A".

REMARKS: _____

_____

_____

_____

_____

_____

_____

Verified By _____ Date _____

EXAMINATION OF PRODUCT

Ref. Para. 4.2.1 EXAMINED TO FOLLOWING CRITERIA

DESIGN DRAWINGS

Ref. Para. 4.2.1.1 TANK CONFORMS TO INSTALLATION DRAWING 2191-001

REVISION _____.

ITEM	REMARKS
IDENTIFICATION:	
DIMENSIONS:	
ASSEMBLY COMPLETENESS:	

CONSTRUCTION

Ref. Para. 4.2.1.2 TANK CONSTRUCTED IN ACCORDANCE WITH INDIVIDUAL INSPECTION REQUIREMENTS OF QTP-2191 SECTION A

COMPLIES WITH PARAGRAPH 3.2.4

REMARKS: _____

_____

_____

COMPLIES WITH PARAGRAPH 3.2.5

REMARKS: _____

_____

_____

MATERIALS

Ref Para. 4.2.1.3 VERIFY CONSTRUCTION MATERIALS:

PURCHASED PARTS

REMARKS: _____

_____

_____

RAW MATERIALS

REMARKS: _____

_____

_____

WORKMANSHIP

Ref: Para. 4.2.1.4 TANK WORKMANSHIP IN ACCORDANCE WITH INDIVIDUAL INSPECTION REQUIREMENTS OF QTP-2191 SECTION "A"

COMPLIES WITH PARAGRAPH 3.2.4.3

REMARKS: _____

_____

_____

_____

COMPLIES WITH PARAGRAPH 3.2.4.4

REMARKS: _____

_____

_____

_____

COMPLIES WITH PARAGRAPH 3.2.4.5

REMARKS: _____

_____

_____

_____

COMPLIES WITH PARAGRAPH 3.2.4.6

REMARKS: _____

_____

_____

_____

EXTERIOR SURFACE FINISH

Ref. Para. 4.2.1.5 TANK EXTERIOR SURFACE IN ACCORDANCE WITH TECHNICAL EXHIBIT ASD/ENFEA-78

COMPLIES WITH PARAGRAPH 4.6.1.1

REMARKS: _____

EXTERIOR SURFACE MARKINGS

Ref. Para. 4.2.1.6 TANK EXTERIOR MARKINGS IN ACCORDANCE WITH INSTALLATION DRAWING 2191-001

COMPLIES WITH DRAWING AND PARAGRAPH 3.10.2. of ASD/ENFEA-78

REMARKS: _____

INTERCHANGEABILITY

Ref. Para. 4.2.1.7 INTERCHANGEABILITY OF ALL REPLACEABLE OR INTERFACE PARTS

INTERCHANGEABILITY WITH PYLON MASTER GAGE

REMARKS: _____

_____

_____

INTERCHANGEABILITY OF REPLACEABLE PARTS

	PART NO.	REMARKS
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

EVALUATION OF DATA

DESIGN:

CONSTRUCTION:

WORKMANSHIP:

EXTERIOR FINISH:

DOCUMENT NUMBER

QTP-2191 SECTION "C"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR ASSEMBLED TANK CONTOUR

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 3/31/81

CHECKED BY: R. Stone DATE: 4-1-81

APPROVED BY: C. A. Patmont Jr DATE: 4-1-81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "C"

DATE: 3/31/81

1.0 SCOPE

This procedure covers the requirements for Assembled Tank Contour Test of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831	Test reports, preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.3 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53
2191-006	Liner - 450 gallon tank

SARGENT FLETCHER

77-450-4400	Pylon Assembly - 450 gallon fuel tank.

3.0 REQUIREMENTS

3.1 INSPECTION ARTICLE

Four (4) tank assemblies fully painted and ready for first article inspection (2191-001) shall be securely fastened to a pylon (27-450-4400) and examined for compliance with the assembled tank contour conditions of Technical Exhibit ASD/ENFEA-78, Paragraph 3.9.4.

3.2 TEST METHOD

Each tank secured to the integral pylon shall be accurately inspected for assembled tank contour and fit of the integral pylon (27-450-4400) contour to the tank contour.

3.2.1 ACCURACY OF CONTOUR

The accuracy shall be a repeatable function of the tank liner contour (2191-006) and held within the tolerance requirements of the Engineering drawing.

3.2.2 SMOOTHNESS OF CONTOUR

The tank contour shall be smooth and there shall be no bump or valleys in the contour greater than the Engineering drawing tolerance over any six (6) inches of the outside tank surface except around fitting or access openings.

3.3 INSPECTION EQUIPMENT

The inspection equipment required to verify compliance of the tank contour to Engineering drawing shall include an approved master contour template and a twenty-four (24) inch flexible scale. All other inspection equipment shall be of good commercial quality and in proper working condition. The contour template contour shall be within ± .030 inches.

3.3.1 INSTRUMENTATION CALIBRATION

All contour inspection equipment shall have been calibrated or inspected within the previous calibration period.

3.4 DOCUMENTATION

At the conclusion of testing, a test report will be prepared for submission to Fiber Science Engineering Dept. Any out of contour condition shall be addressed in detail.

4.0 QUALIFICATION TEST PROVISIONS

4.1 SUBMISSION FOR CONTOUR INSPECTION

Each tank and pylon submitted for contour inspection shall be reviewed for completeness of assembly and compliance with previous qualification test procedures. The results of this inspection shall be recorded.

4.2 INSTRUMENTATION AND TEST EQUIPMENT

4.2.1 INSTRUMENTATION CALIBRATION

All inspection instruments shall be inspected to verify that it has had a calibration check within the last calibration period.

4.2.2 CONTOUR TEMPLATE ACCURACY

The contour template shall be inspected to verify that it has been accurately fabricated to a tolerance within 25% of the contour tolerance of the applicable contour drawing.

4.3 TANK CONTOUR

Inspect each tank and pylon to verify compliance of the contour to the requirements of Paragraph 3.2 and the applicable Engineering drawings.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the inspection is complete. This report is to include all recorded contour deviations if any. The test tank shall be retained for further testing.

APPENDIX "C"

TEST DATA SHEETS

TEST DATA SHEET

QTR-2191 SECTION "C"

Testing Activity _____ Activity Test Engr. _____

Tank Serial No. _____ F.S.I. Test Engr. _____

Test Date _____ Government Rep. _____

SUBMISSION FOR CONTOUR INSPECTION

Ref. Para. 4.1: Completeness of Assembly: _____

_____

_____

Compliance with Previous Qualification Tests: _____

_____

_____

Visual Inspection: _____

_____

_____

INSTRUMENTATION AND TEST EQUIPMENT CALIBRATION

Ref. Para 4.2.1: CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

CONTOUR TEMPLATE ACCURACY

Ref. Para. 4.2.2: VERIFY ACCURACY OF CONTOUR TEMPLATE

Contour Coordinate Document

REMARKS: _____

_____

_____

_____

_____

Contour Template Characteristics
(That is stand off or net fit template and how used)

REMARKS: _____

_____

_____

_____

_____

Inspection for Accuracy

REMARKS: _____

_____

_____

_____

_____

NOTE: Supply inspection of template data sheet.

TANK CONTOUR

Ref. Para. 4.3: VERIFY COMPLIANCE OF TANK CONTOUR

Contour Tolerance from Engineering Drawing

Tolerance: _____

Contour Inspection

Forward Eliptical: _____

_____

_____

_____

Center Straight: _____

_____

_____

_____

Aft Eliptical: _____

_____

_____

_____

Pylon Contour Fit: _____

_____

_____

_____

TANK CONTOUR

Ref. Para. 4.3: VERIFY COMPLIANCE OF CONTOUR SMOOTHNESS

Contour Smoothness Tolerance From Engineering Drawing

Tolerance: _____

Deviations If Any And Location: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Approximate Surface Finish (RMS)

_____

_____

_____

_____

_____

_____

EVALUATION OF DATA

TANk CONTOUR:

PYLON CONTOUR FIT:

TANK CONTOUR SMOOTHNESS:

APPROXIMATE SURFACE FINISH:

DOCUMENT NUMBER

QTP-2191 SECTION "D"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR ASSEMBLED TANK WEIGHT

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Ignor DATE: 2/11/81

CHECKED BY: R. Stone DATE: 3-27-81

APPROVED BY: C. A. Patnode Jr DATE: 3/27/81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "D"

DATE: 2/11/81

1.0 SCOPE

This procedure covers the requirements for Assembled Tank Weight Test of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831	Test reports, preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.3 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel tank.

3.0 REQUIREMENTS

3.1 TEST ARTICLE

Four (4) tank assemblies fully painted and ready for first article test (2191-001) shall be securely fastened to a pylon (27-450-4400) and examined for compliance with the assembled tank weight conditions of Technical Exhibit ASD/ENFEA-78, Paragraph 4.6.9.

3.2 TEST METHOD

Each tank secured to the integral pylon shall be accurately weighed and the weight recorded on the data sheet and on the tank nameplate.

3.3 TEST INSTRUMENTATION

The weighing device used for this procedure shall be of good commercial quality and in proper working condition. The weighing device shall be capable of accurately reading the fuel tank weight to within 1/2 pound over the full scale of the device

3.3.1 INSTRUMENTATION CALIBRATION

The weighing device shall have been calibrated within the previous calibration period.

3.4 DOCUMENTATION

At the conclusion of testing, a test report will be prepared for submission to the contractor. Any overweight condition shall be addressed in detail.

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

Each tank and pylon shall be fully examined prior to weighing for completeness of assembly and compliance with previous qualification test procedures. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 INSTRUMENTATION AND TEST EQUIPMENT

4.2.1 INSTRUMENTATION CALIBRATION

The weighing device shall be inspected to verify that it has had a calibration check within the last calibration period.

4.2.2 OPERATION

The weighing device shall be checked for proper operation. Any defects in the device shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.3 ASSEMBLED TANK WEIGHT

Each tank and pylon shall then be mounted to or placed on the weighing device and weighed separately and combined. Record total weight on data sheets and tank nameplate.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded inspection and weight data sheets. The test tank shall be retained for futher testing.

APPENDIX "A"

TEST DATA SHEETS

TEST DATA SHEET

QTR-2191 SECTION "D"

Testing Activity _____ Activity Test Engr. _____

Tank Serial No. _____ F.S.I. Test Engr. _____

Test Date _____ Government Rep. _____

EXAMINATION OF PRODUCT

Ref. Para. 4.1: Completeness of Assembly: _____

_____

_____

Compliance with Previous Qualification Tests: _____

_____

_____

Visual Inspection: _____

_____

_____

INSTRUMENTATION

Ref. Para. 4.2.1: CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
Weighing Device	_____
Other Instruments:	_____
1. _____	_____
2. _____	_____

Ref. Para. 4.2.2 CHECK PROPER OPERATION

ITEM	REMARKS
Weighing Device	_____
Other Instruments:	_____
1. _____	_____
2. _____	_____

ASSEMBLED TANK WEIGHT

Ref. Para. 4.3: WEIGH COMPLETELY ASSEMBLED TANK AND PYLON

ITEM	WEIGHT
Tank Assembly	_____
Pylon Assembly	_____
Combined Assembly	_____

EVALUATION OF DATA

TANK ASSEMBLY WEIGHT: _____

PYLON ASSEMBLY WEIGHT: _____

TANK AND PYLON ASSEMBLY WEIGHT: _____

WEIGHING DEVICE: _____

DOCUMENT NUMBER

QTP-2191 SECTION "E"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR FUNCTIONAL TEST

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 12/29/80

CHECKED BY: James O. Gumbaker DATE: 12-30-80

APPROVED BY: C. L. Patnode Jr DATE: 12/30/80

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "E"

DATE: 12/29/80

1.0 SCOPE

This procedure covers the requirements for the General and the Compatibility Functional Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-STD-831	Test Reports, Preparation of.

2.2 FEDERAL SPECIFICATION

P-D-680	Dry Cleaning Solvent
TT-S-735	Standard Test Fluid, Hydrocarbon

2.3 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.4 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel tank.

3.0 REQUIREMENTS

3.1 TEST ARTICLE

3.1.1 GENERAL

Four (4) tank assemblies (2191-001) equipped with a Government furnished pylon (27-450-4400) shall be subjected to the General Functional Test requirements of Paragraph 4.6.11 as described in Technical Exhibit ASD/ENFEA-78.

3.1.2 COMPATIBILITY

One of the four (4) tanks of Paragraph 3.1.1 shall also be installed on an operational H-53 Helicopter to demonstrate proper installation or fit to the aircraft and servicing compatibility to the requirements of Paragraph 4.6.11.2 of the Technical Exhibit ASD/ENFEA-78.

3.2 TEST ARRANGEMENT

3.2.1 GENERAL

The General Test Arrangement for the four tank assemblies shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.2.2 COMPATIBILITY

The Compatibility Test Arrangement for one of the four tank assemblies shall be as shown in Figure 2, that is, installing one of the test articles to the H-53 Helicopter.

3.3 TEST METHOD

3.3.1 TEST SETUP

3.3.1.1 GENERAL

The tank, mounted to the pylon, shall be suspended in a 2^0 nose down position from the test fixture, as shown in Figure 1. The fuel and air fittings shall automatically open as the tank is mounted to the test fixture. The operational hydraulic schematic for fueling and defueling of the tank with the test fluid is shown in Figure 3. The test fluid shall be one of the following:

(a) Stoddard Solvent per P-D-680
(b) Type II Fluid per TT-S-735
(c) JP-4 per MIL-T-5624
(d) JP-5 per MIL-T-5624

When the tank is securely mounted to the test fixture, an approved capacitance test meter shall be connected to the tank capacitance fuel probe to measure the fuel volume in the tank. The operational electrical schematic for the capacitance fuel probe test is shown in Figure 4.

The General Test Setup shall be completed by connecting a 28 volt DC indicator light or buzzer to the tank full and empty float switches. The operational electrical schematic for the full and empty float switch is shown in Figure 5.

3.3.1.2 COMPATIBILITY

The test setup for proper installation and function of the tank with the aircraft shall be determined by the testing activities test engineer and/or technician and an outlined description of the operational fuel, defueling and electrical aspects of the test setup shall be transmitted to the Fiber Science Test Engineer.

3.3.2 FUNCTIONAL TEST

3.3.2.1 GENERAL TEST

3.3.2.1.1 DRY FUEL TEST

With all fuel, air and electrical connections completed, check the dry or empty fuel capacitance reading for compliance with the meter characteristics as guaranteed by the meter manufacturer and the capacitance probe manufacturer. The meter/probe dry fuel capacitance characteristics once

established shall not vary more than ± 1.5 pico farads.

During this test the empty indicator light or buzzer should be activated by the empty tank float switch.

3.3.2.1.2 WET FUEL TEST

Activate the automatic fuel/defuel valve on the test fixture and fuel the tank at the rate of 50 gallons per minute with a maximum pressure of 10 psig. The full tank float switch shall activate and close the automatic fuel valve when the tank is full (450 to 457 gallons). The full tank float switch shall also have activated the full indicator light or buzzer. The full fuel capacitance shall be checked to the manufacturer's established values. The established full fuel capacitance characteristics once established shall not vary more than ± 12.5 pico farads.

3.3.2.1.3 DEFUELING TEST

The automatic fuel/defuel valve shall be switched to the defuel position and the tank shall be defueled by pressurizing through the vent valve with 30 to 45 psig air pressure. The pressure shall be adjusted so that the differential pressure drop across the fuel/defuel valve is 15 psig. The tank shall be capable of defueling at a minimum rate of 85 gallons per minute. When the tank is empty, the empty tank indicator light or buzzer should be activated.

3.3.2.2 COMPATIBILITY TEST

3.3.2.2.1 DRY FUEL TEST

The H-53 Helicopter tank empty indicator mechanism shall be actuated and the fuel quantity gauge shall read properly for an empty tank condition before the tank is fueled.

3.3.2.2.2 WET FUEL TEST

The tank shall be fueled to a full tank condition and the H-53 Helicopter tank full indicator mechanism shall be activated. The fuel quantity gauge shall also read properly for a full tank condition.

3.3.2.2.3 DEFUELING TEST

The tank shall be automatically drained to an empty tank condition. The fuel quantity gauge shall read properly for an empty tank condition and the tank float switch shall activate the aircraft empty tank indicator mecnanism and if applicable close the tank defuel valve.

3.4 TEST INSTRUMENTATION

3.4.1 GENERAL TEST

Test instrumentation shall be those gauges, meters, and indicators shown in the operational schematics of Figure 3, 4, and 5, and each shall be capable of displaying continuous reading during the test.

3.4.2 COMPATIBILITY TEST

Test instrumentation shall be those gauges, meters, and indicators normally used aboard the H-53 Helicopter for ground refueling and inflight fuel monitoring. In addition a full color 16 mm movie and 12 still photographs shall be taken to document installation procedures and establish any problems that may exist, such as improper handling, improper fit or improper operation of the fueling or defueling mechanisms.

3.4.3 INSTRUMENTATION CALIBRATION

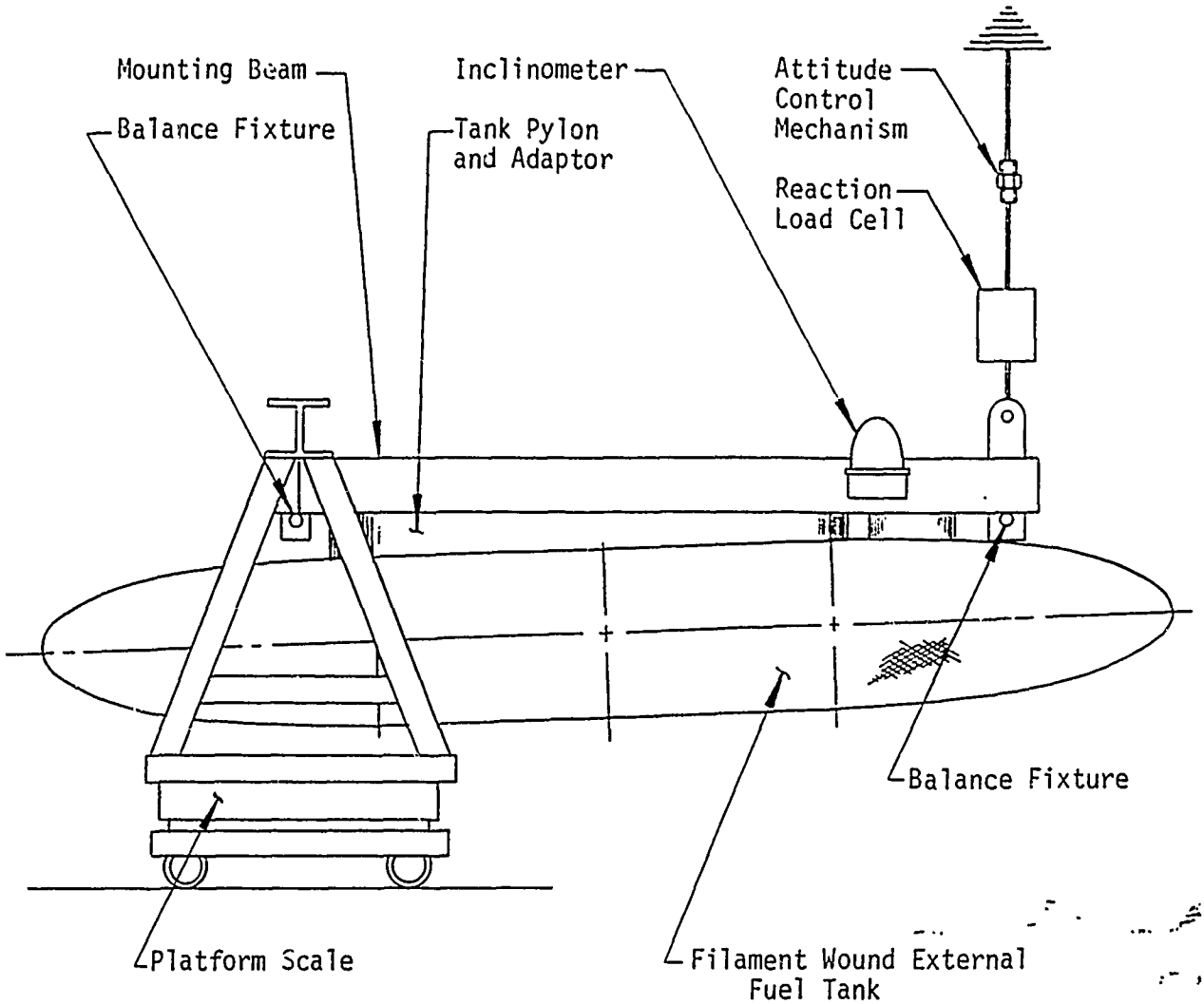
All instrumentation shall be calibrated and capable of reading or recording data within ± 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.6 DOCUMENTATION

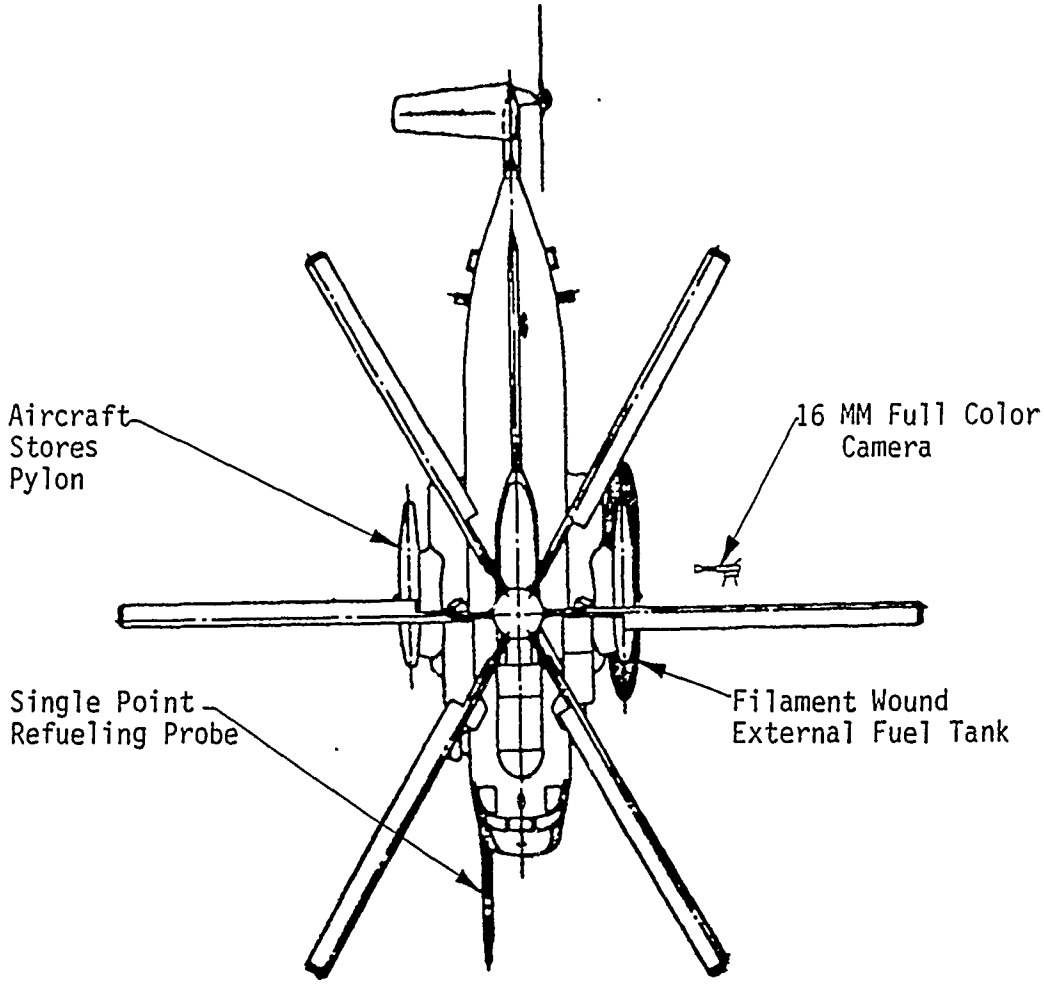
At the conclusion of testing a test report shall be prepared for submission to the contractor.



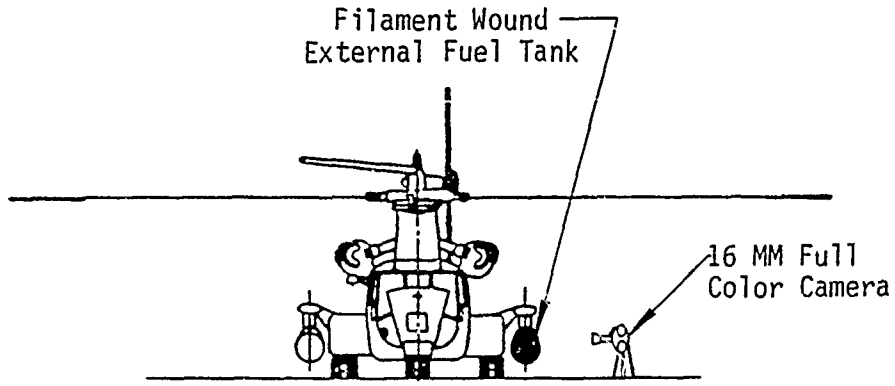
FUNCTIONAL TEST FIXTURE

FIGURE 1

GENERAL TEST ARRANGEMENT



HELICOPTER TOP VIEW



HELICOPTER FRONT VIEW

FIGURE 2

H-53 HELICOPTER COMPATIBILITY TEST ARRANGEMENT

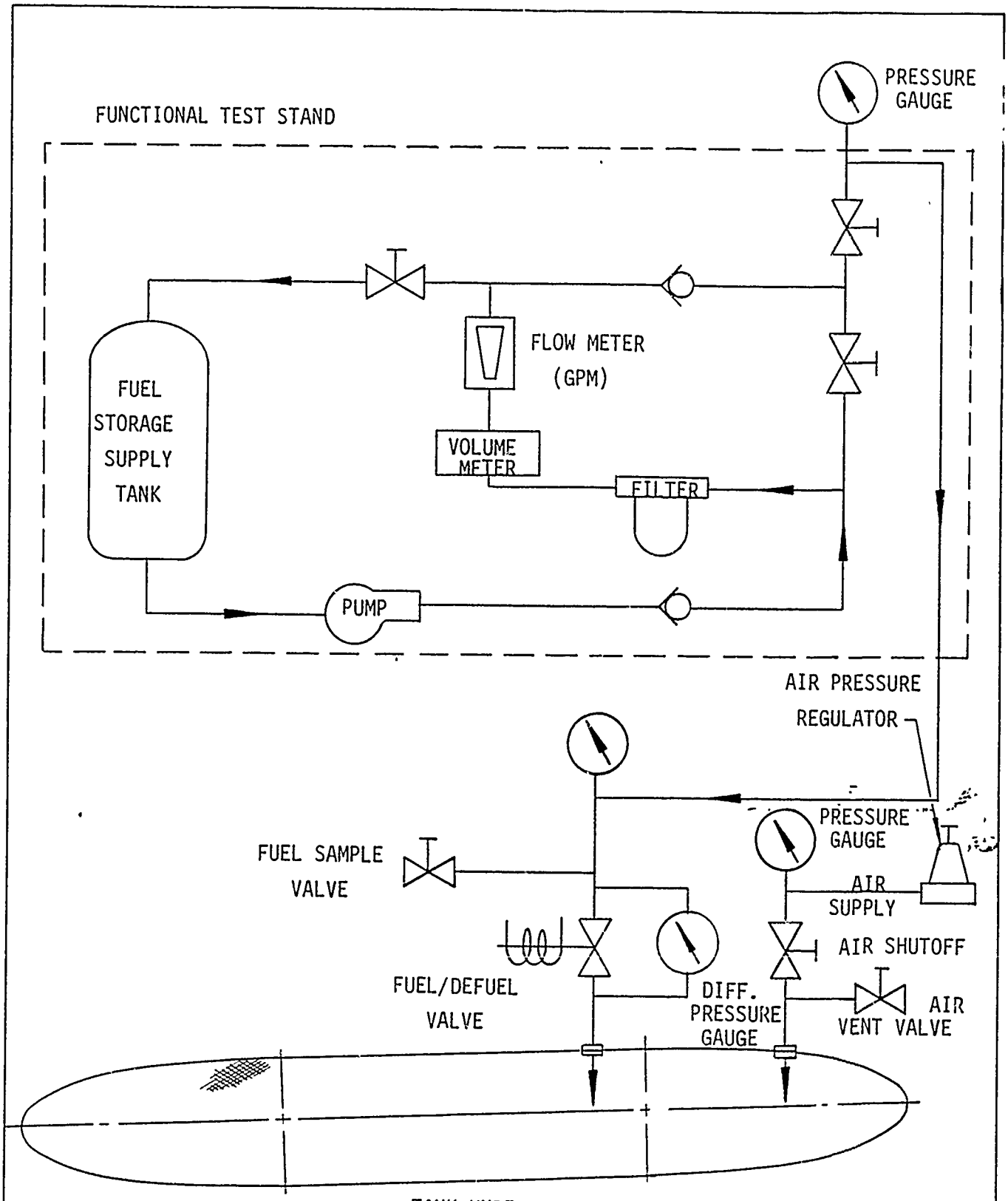
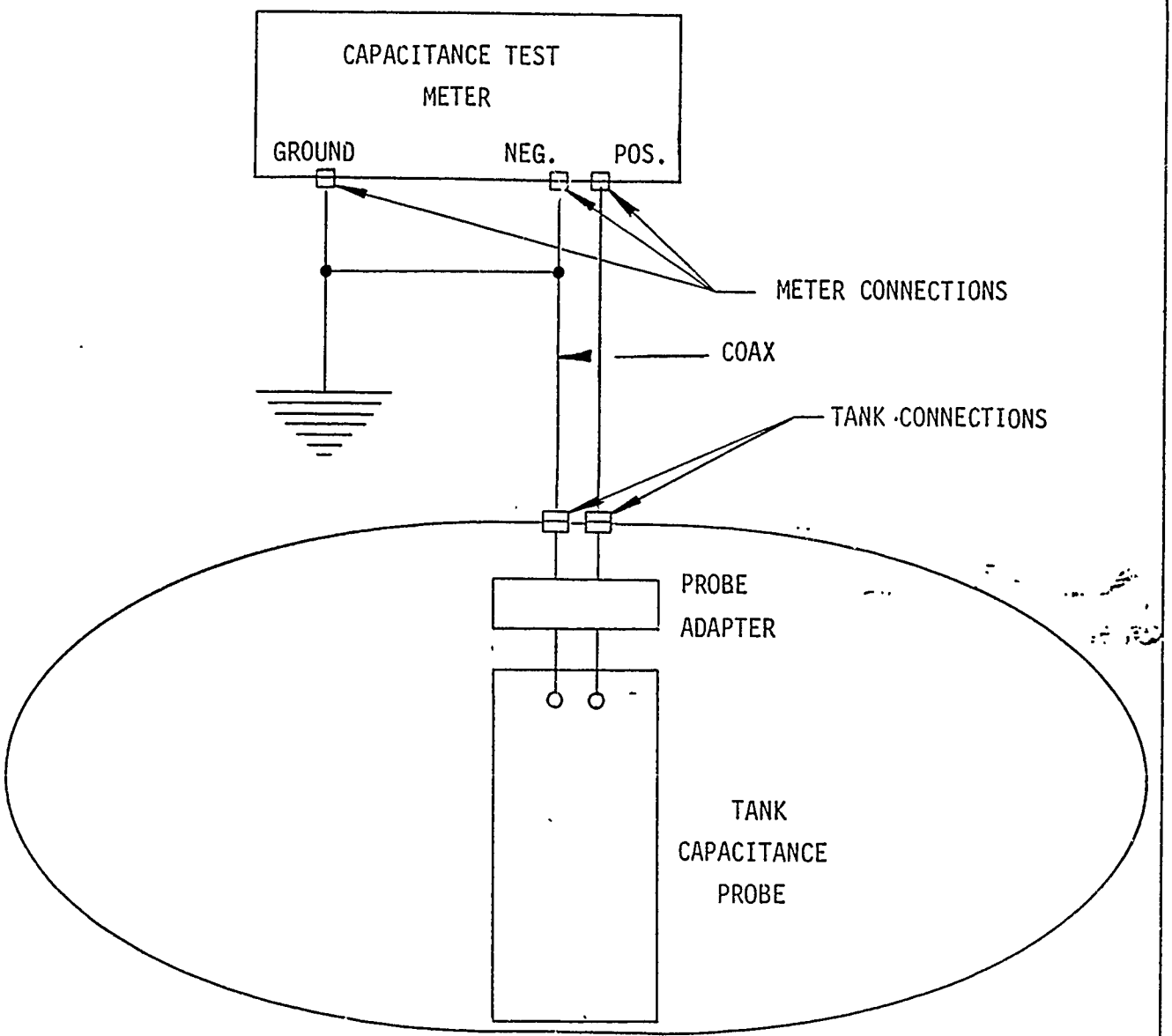


FIGURE 3

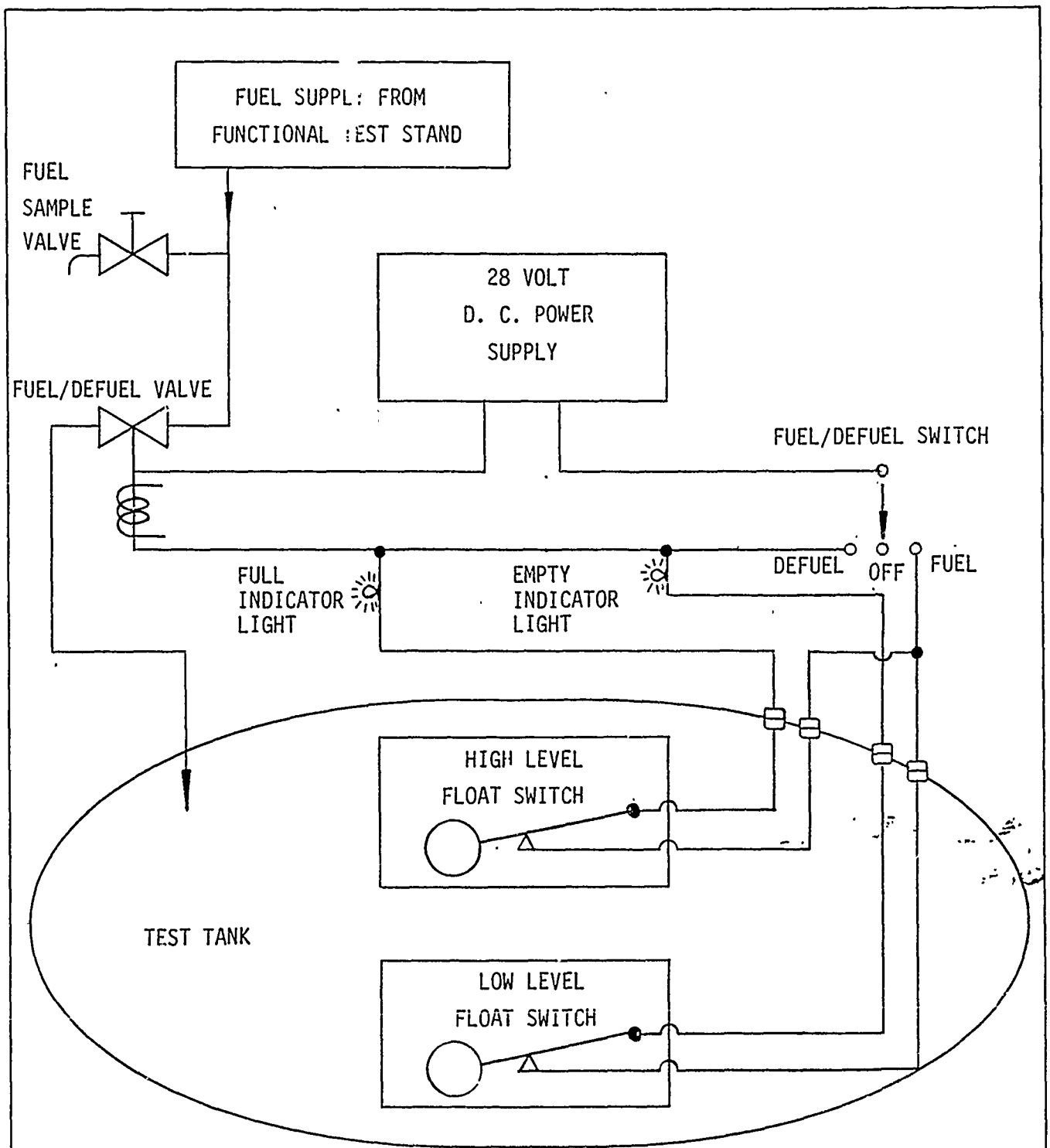
OPERATIONAL HYDRAULIC SCHEMATIC



FUEL TANK WITH CAPACITANCE PROBE

FIGURE 4

OPERATIONAL ELECTRICAL SCHEMATIC FUEL CAPACITANCE PROBE TEST



FUEL TANK WITH FLOAT SWITCHES

FIGURE 5

OPERATIONAL ELECTRICAL SCHEMATIC FLOAT SWITCH TEST

4.0 QUALIFICATION TEST PROCEDURES

4.1 EXAMINATION OF PRODUCT

4.1.1 GENERAL EXAMINATION

Each tank and pylon shall be fully examined prior to mounting to the test stand for compliance with Qualification Test Procedures Section "A" through "D". The results of this inspection shall be recorded in the respective test section of each document and verification that this has been accomplished shall be noted on the test data sheets of Appendix A of this test procedure.

4.1.2 COMPATIBILITY EXAMINATION

The selected tank and pylon for this test shall be fully examined prior to mounting to the H-53 Helicopter for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

4.2.1 GENERAL TEST

Each tank and pylon shall then be mounted to the test fixture and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.2.2 COMPATIBILITY TEST

The selected tank and pylon shall be mounted to the H-53 Helicopter and examined for proper attachment and fit to the aircraft. Any signigicant variations or deviations shall be recorded.

4.3 ARRANGEMENT

4.3.1 GENERAL TEST

The test arrangement shall be examined for compliance with Figure 1, 3, 4, and Figure 5 of this procedure and applicable paragraphs of ASD/ENFEA-78 Technical Exhibit.

4.3.2 COMPATIBILITY TEST

The test arrangements shall be examined for compliance with Figure 2 of this procedure and the testing activities requirements for performing a fit and function test on the H-53 Helicopter. If available a fueling/defueling and electrical schematic of the H-53 Helicopter external tank fuel system should be acquired as part of the test documentation data.

4.4 INSTRUMENTATION

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period. Record the calculated meter/probe dry tank capacitance values in accordance with Paragraph 3.3.2.1.1 of this document.

Instrumentation calibration aboard the H-53 Helicopter shall be verified by the testing activity.

4.4.2 MONITORING

All instruments required for recording test data shall either be manned by a test technician or employ a synchronized continuous recording device.

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 GENERAL FUNCTIONAL TEST

4.5.1 DRY FUEL TEST

With all instrumentation energized record the dry fuel capacitance and whether the empty tank float switch indicator light or buzzer is on. The capacitance reading shall be in accordance with Paragraph 3.3.2.1.1 of this document.

4.5.2 WET FUEL TEST

With all instrumentation still energized, close the air supply valve and open the vent valve. Activate the fuel/defuel valve by moving the switch to the fuel position. Record the following:

(a) The fuel flow rate in gallons per minute at a maximum pressure of 10 psig. The minimum flow rate allowable shall be 50 gallons per minute.
(b) The air pressure required to provide a flow rate of 50 gallons per minute. The maximum gauge pressure allowable shall be 10 psig.
(c) Verify that the float switch activated the fuel/defuel valve to stop the fuel flow when the tank was full.
(d) Record the actual amount of fuel in the tank by weight. The useable fuel volume shall be between 450 and 457 gallons.
(e) Record the wet fuel capacitance. The capacitance value shall be in accordance with the requirements of Paragraph 3.3.2.1.2 of this document.

4.5.3 DEFUELING TEST

Close the vent valve and open the air supply valve. Adjust the air supply valve to 15 psig and place the fuel/defuel switch in the defuel position. Record the defueling rate. The tank and plumbing shall be capable of being defueled at the rate of 85 gallons per minute.

Verify that the empty tank float switch shut off the fuel/defuel valve and activated the empty tank indicator light or buzzer.

4.5.4 FUEL DRAIN

Close the air supply valve and open the vent valve. With the fuel/defuel valve in the off position open the tank drain and remove the remaining fuel from the tank. The measured sump fuel removed from the tank shall be 1.00 to 1.25 gallons.

4.6 COMPATIBILITY FUNCTIONAL TEST

4.6.1 DRY FUEL TEST

With all instrumentation energized record the fuel quantity gauge reading. The fuel quantity gauge readings shall be the same as that recorded when the standard external fuel tank is used.

Verify that the empty tank indicator mechanism has been activated if such a mechanism exists aboard the helicopter or on refueling panel.

4.6.2 WET FUEL TEST

With all instrumentation still energized fuel the tank to a full tank condition. Record the following values if such instrumentation exists aboard the aircraft to do so relative to those values achieved when the standard external fuel tank is used:

(a) The fuel flow rate in gallons per minute at a maximum pressure of 10 psig. The minimum flow rate allowable is 50 gallons per minute.
(b) The air pressure required to provide a flow rate of 50 gallons per minute. The maximum gauge pressure allowable shall be 10 psig.
(c) Verify that the float switch activated the fueling valve if applicable to stop the fuel flow when the tank is full.
(d) Record if applicable the amount of fuel in the tank either by flow meter or gauge. The useable fuel volume shall be between 450 and 457 gallons.

4.6.3 DEFUELING TEST

Defuel the tank to an empty tank condition. The tank fuel system should be capable of defueling at a rate of 85 gallons per minute if the helicopter defueling pressure system is capable of producing 30 to 45 psig air pressure to the tank for defueling. Record the pressure at which 85 gallons per minute is achieved.

4.6.4 FUEL DRAIN

With all fuel systems de-energized open the drain valve and remove the remaining fuel from the tank. The measured sump fuel removed from the tank shall be 1.00 to 1.25 gallons.

5.0 QUALIFICATION REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report shall include all recorded functional test data sheets, 16 mm movie film and still photos used to document the compatibility of the tank and pylon to the helicopter. The tank used for the Functional Compatibility Test shall be returned to Fiber Science for further testing in the same shipping container it was received in.

APPENDIX "A"

TEST DATA SHEETS

TEST DATA SHEET

QTR-2191 SECTION "E"

Testing Activity_____ Activity Test Engr._____

Tank Serial No._____ F.S.I. Test Engr._____

Test Date_____ Government Rep._____

EXAMINATION OF PRODUCT

Ref. Para. 4.1.1 GENERAL EXAMINATION

Verify that the test article has successfully passed the previous test.

TEST	COMPLETED	REMARKS
a. Individual Inspection per QTP-2191 Section "A"		
b. Examination of Product per QTP-2191 Section "B"		
c. Tank Contour per QTP-2191 Section "C"		
d. Assembled Tank Weight per QTP-2191 Section "D"		

Ref. Para. 4.1.2 COMPATIBILITY EXAMINATION

Visual Inspection_____

_____

_____

_____

Delaminations (Tap Test)_____

_____

_____

_____

MOUNTING

Ref. Para. 4.2 GENERAL TEST

Aircraft Simulated Attachment

Deviations if any _____

_____

_____

_____

_____

Ref. Para. 4.2.2 COMPATIBILITY TEST

Aircraft Attachment (Supply sketch if necessary to describe fit or connection problems).

Primary Pylon Fit _____

_____

Stub Pylon Fit _____

_____

Fuel Connection _____

_____

Air Connection _____

_____

Float Switch Electrical Connection _____

_____

Fuel Probe Electrical Connection _____

_____

ARRANGEMENT

Ref. Para. 4.3

GENERAL TEST

Approved Test Arrangement
(Ref. Figures 1, 3, 4, 5, & ASD/ENFEA-78
Technical Exhibit)

Testing Activity Approval

Approved By_____ Date _____

F.S.I. Test Engineer Approval

Approved By _____ Date _____

Government Approval

Approved By _____ Date _____

Minimum of two signatures required.

Ref. Para 4.3.2

COMPATIBILITY TEST

Inspection and acquisition of fueling/defueling and electrical schematic of the H-53 Helicopter External Tank Fuel System.

Remarks: _____

_____

_____

_____

_____

_____

_____

Verify Compliance With Schematic.

_____

Approved Test Arrangement
(Ref. Figure 2 & ASD/ENFEA-78 Technical Exhibit)

Testing Activity Approval

Approved By _____ Date _____

F.S.I. Test Engineer Approval

Approved By _____ Date _____

Government Approval

Approved By _____ Date _____

Minimum of two signatures required.

INSTRUMENTATION

Ref. Para. 4.4.1 CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
Fuel Quantity Gauges	_____
Flow Meters (If Applicable)	_____
Pressure Gauges (If Applicable)	_____
Capacitance Meters (If Applicable)	_____
Timing Devices	_____
Other Instruments:	
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

Ref. Para 4.4.2 CHECK INSTRUMENTATION MONITORING

All instrumentation is manned or synchronized with a continuous recording device.

Remarks _____

_____

_____

_____

Ref. Para 4.4.3 CHECK FOR PROPER OPERATION

ITEM	REMARKS
Fuel/Defuel Valve	_____
System Pump	_____
Flow Meters (If Applicable)	_____
Gauges	_____
Switches	_____
Cameras (If Applicable)	_____
Other Instruments:	
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

GENERAL FUNCTIONAL TEST

Ref. Para. 4.5.1 **DRY FUEL TEST**

ITEM	REMARKS
System Energized	
Empty Tank Indicator Light or Buzzer On	
Manufacturer's Meter/ Probe Dry Fuel Capacitance Valve	
Actual Dry Fuel Capacitance Reading (± 1.5 Pico Farads of Manufacturer's Value)	

Ref. Para. 4.5.2 **WET FUEL TEST**

ITEM	REMARKS
System Fueling	
Flow Rate at 10 PSIG	
Air Pressure at 50 GPM	
Float Switch Shut Off Fuel Value When Tank was Full	
Full Tank Indicator Light or Buzzer On	
Weight/Gallons of Fuel in Tank	
Manufacturer's Meter/Probe Full Tank Capacitance Value	
Actual Dry Fuel Capacitance Reading (± 12.5 Pico Farads of Manufacturer's Value)	

Ref. Para. 4.5.3 DEFUELING TEST

ITEM	REMARKS
Defueling Air Pressure at which 85 GPM was achieved.	
Empty Tank Indicator Light or Buzzer on.	
Actual Empty Tank Capacitance Reading.	

Ref. Para. 4.5.4 FUEL DRAIN

ITEM	REMARKS
Actual Amounts of Sump Fuel collected from Draining Tank.	

COMPATIBILITY FUNCTIONAL TEST

Ref. Para. 4.6.1 DRY FUEL TEST

ITEM	REMARKS
System Energized	
Empty Tank Indicator Mechanism On	
Standard Aircraft Dry Fuel Quantity Gauge Reading	
Actual Aircraft Dry Fuel Quantity Gauge Reading	

Ref. Para. 4.6.2 WET FUEL TEST

ITEM	REMARKS
System Fueling	
Flow Rate at 10 PSI	
Air Pressure at 50 GPM	
Float Switch Shut Off Fuel Valve When Tank Was Full	

	Full Tank Indicator Mechanism On	_____
	Standard Aircraft Full Quantity Gauge Reading	_____
	Actual Aircraft Full Quantity Gauge Reading	_____

Ref. Para 4.6.3 DEFUELING TEST

ITEM	REMARKS
Defueling Air Pressure at which 85 GPM was achieved	_____
Empty Tank Indicator Mechanism On	_____
Actual Empty Tank Fuel Quantity Gauge Reading	_____

Ref. Para. 4.6.4 FUEL DRAIN

ITEM	REMARKS
Actual Amount of Sump Fuel collected from Draining Tank	_____

EVALUATION OF DATA

FUELING/DEFUELING:

CAPACITANCE PROBE:

FLOAT SWITCHES:

FIT CHECK:

DOCUMENT NUMBER

QTP-2191 SECTION "F"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR

FIRST ARTICLE PRESSURE TEST

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 2/5/81

CHECKED BY: R. Stone DATE: 2-10-81

APPROVED BY: C. A. Patmont Jr. DATE: 2/11/81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "F"

DATE: 2/5/81

1.0 SCOPE

This procedure covers the requirements for First Article Pressure Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-T-5624	Turbine fuel, aviation grade JP-4 and JP-5.
MIL-STD-831	Test reports, preparation of.

2.2 FEDERAL SPECIFICATION

P-D-680	Dry cleaning solvent

2.3 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.4 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel tank.

3.0 REQUIREMENTS

3.1 TEST ARTICLE

EACH TANK ASSEMBLY
~~Four (4) tank assemblies~~ (2191-001) shall be securely fastened to a pylon (27-450-4400) which in turn is mounted to the test fixture by means of a simulated airframe adaptor. Each tank shall then be fueled to a full tank condition and subjected to the first article testing conditions of Technical Exhibit ASD/ENFEA-78, Paragraph 4.6.12.2.

450 GALLON

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 POSITIVE PRESSURE TEST METHOD

Each tank secured to the pylon support points shall be suspended from the functional test fixture in a 2^{0} nose down position. Each tank shall then be filled to a full tank condition with 450 to 457 gallons of JP-5 fuel per MIL-T-5624 or Stoddard Solvent per P-D-680. Each tank shall then be pressurized to 86 $\pm$ 2 psi for three (3) minutes without leakage.

3.4 NEGATIVE PRESSURE TEST METHOD

Each tank after completion of the positive pressure test shall be drained and a 10 $\pm$ 1/2 psi negative pressure applied to each tank for three minutes without leakage or rupture.

3.5 TEST INSTRUMENTATION

A staining agent or flourescent dye shall be mixed in the test fluid to aid in the detection of leakage. If a staining agent is used, brown paper should be placed snuggly over all access openings or ports to detect leakage. If a fluorscent dye is used, an ultraviolet light should be acquired to visually detect leakage. Calibrated quality pressure regulator and pressure and vacuum gauges shall be used.

3.5.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within ± 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.6 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.7 DOCUMENTATION

At the conclusion of testing, a test report will be prepared for submission to the contractor.

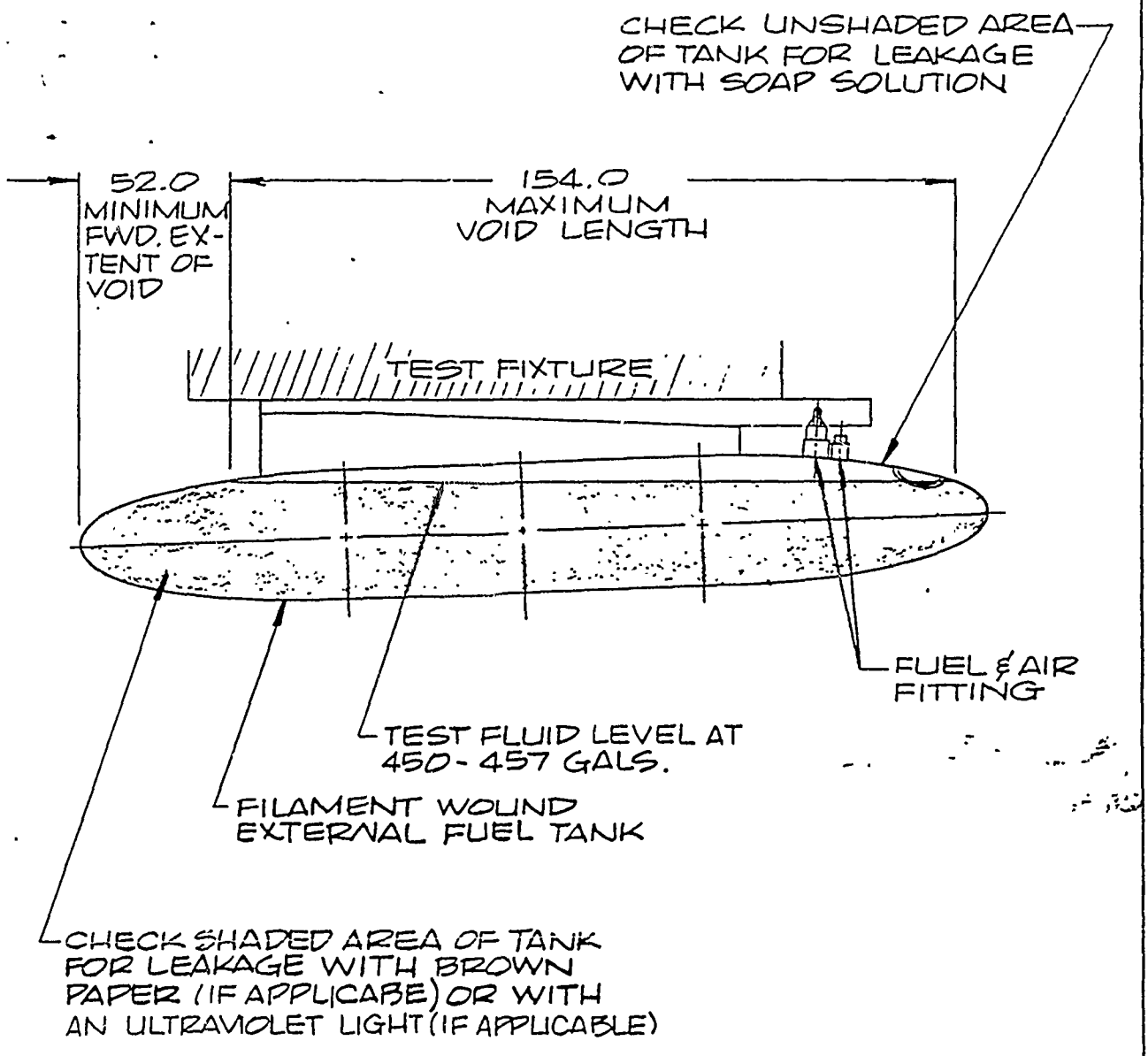


FIGURE 1

PRESSURE TEST ARRANGEMENT

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

Each tank and pylon shall be fully examined prior to mounting to the test fixture for damage. This examination shall include a visual inspection and a tap test for delaminations if not accomplished as part of the final inspection from previous test. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

Each tank and pylon shall then be mounted to the test fixture in a 2^{o} nose down attitude by means of the simulated airframe adaptor and examined for proper attachment and assimilation to the actual aircraft installation. Install all fuel, air, and electrical connections for simulated operation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure or shall be deemed to be in compliance with the applicable paragraphs of ASD?ENFEA-78 Technical Exhibit and approved by an authorized Fiber Science Test Engineer and an authorized Government representative.

4.4 INSTRUMENTATION AND TEST EQUIPMENT

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All pressure and vacuum gauges shall be installed so as to have little or no affect on the test other than to provide accurate pressure and vacuum readings.

4.4.3 OPERATION

All test equipment shall be checked for proper operation. Any defects in equipment shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 FUELING

Each tank shall be filled with 450 to 457 gallons of JP-5 fuel or Stoddard Solvent in which an approved fluorescent dye or staining agent has been added for leak detection. Each tank will be full when the float switch actuates a full tank warning device. Each tank will also be properly filled when the test fluid pours out the open vent line. If a staining agent is used in the test fluid, place brown paper snugly around all fittings or ports in the fuel portion of the tank. See Figure 1.

4.6 POSITIVE PRESSURE TEST

When each tank is full, close the vent valve and pressurize the tank to 86 $\pm$ 2 psi for three (3) minutes.

4.6.1 POSITIVE PRESSURE TEST INSPECTION

Soap solution test the fuel void portion of each tank as shown in Figure 1. Leakage in this portion of the tank will be indicated by the presence of air bubbles forming in the soap solution. If a staining agent has been used in the test fluid, inspect all brown paper covered fittings and ports for test fluid stains to detect leakage. If a fluorescent dye is used in the test fluid, an ultraviolet light should be used to visually detect the presence of the red dye for leakage. There shall be no leakage during this test.

4.7 NEGATIVE PRESSURE TEST

Reduce pressure to zero (0) and drain each tank of all test fluid. Connect vacuum line to fuel or vent port. With all other ports closed, evacuate each tank of air to a negative 10 psig. Close vacuum valve and hold vacuum for three (3) minutes.

4.7.1 NEGATIVE PRESSURE TEST INSPECTION

Inspect each tank and vacuum gauge for leak detection. There shall be no leakage, rupture or failure of any of the tanks. There shall be no drop in the vacuum gauge reading during the test.

4.8 POST PRESSURE TEST EXAMINATION

Following the foregoing pressure tests, each tank shall be opened and visually inspected for any damage. The entire outer surface of each tank shall be tap tested for delaminations.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded positive and negative pressure data sheets and a record of any leakage and its location if such occurred. Each test tank shall be retained for further testing before returning to Fiber Science, Inc.

APPENDIX "A"

TEST DATA SHEETS

TEST DATA SHEET

QTR-2191 SECTION "F"

Testing Activity _____ Activity Test Engr. _____

Tank Serial No. _____ F.S.I. Test Engr. _____

Test Date _____ Government Rep. _____

EXAMINATION OF PRODUCT

Ref. Para. 4.1: Visual Inspection _____

_____

_____

_____

_____

Delaminations (Tap Test) _____

_____

_____

_____

_____

MOUNTING

Ref. Para. 4.2: Aircraft Simulated Attachment

Deviations If Any _____

_____

_____

_____

_____

ARRANGEMENT

Ref. Para. 4.3: APPROVED TEST ARRANGEMENT
(REF. FIGURE 1 AND ASD/ENFEA-78 TECHNICAL EXHIBIT).

Testing Activity Approval

Approved By _____ Date _____

F.S.I. Test Engineer Approval

Approved By _____ Date _____

Government Approval

Approved By _____ Date _____

Minimum of two signatures required.

INSTRUMENTATION

Ref. Para. 4.4.1: CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
Pressure Gauges	_____
Vacuum Gauges	_____
Other Instruments:	
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

Ref. Para. 4.4.2: CHECK PROPER INSTALLATION

ITEM	REMARKS
Tank	
Simulated Aircraft Adaptor	
Pressure Gauges	
Vacuum Gauges	
Other Instruments:	
1. _____	
2. _____	
3. _____	
4. _____	

Ref. Para. 4.4.3: CHECK PROPER OPERATION

ITEM	REMARKS
Fuel/Defuel System	
Pressure Gauges	
Vacuum Gauges	
Other Instruments:	
1. _____	
2. _____	
3. _____	
4. _____	

FUELING

Ref. Para. 4.5: FUEL TANK AT PROPER ATTITUDE

ITEM	REMARKS
Attitude (2° Nose Down)	
Fill with 450 to 457 Gal. Of Test Fluid	
Type of Leak Detecting Additive	
Amount of Leak Detecting Additive	
Secure All Openings	

POSITIVE PRESSURE TEST

Ref. Para. 4.6: WITH ALL EQUIPMENT AND INSTRUMENTATION WORKING PROPERLY, PRESSURIZE TANK

ITEM	OPERATIONAL REMARKS
Pressure Achieved (86 ± 2 psi)	
Elapsed Time (3 Minutes)	

POSITIVE PRESSURE TEST INSPECTION

Ref. Para. 4.6.1: LEAK CHECK TANK UNDER PRESSURE

Brown Paper Dye Stain Examination for Leakage (If Applicable): _____

Ultraviolet Light Dye Detection for Leakage (If Applicable): _____

Soap Solution Test Void Area for Leakage (See Figure 1): _____

NEGATIVE PRESSURE TEST

Ref. Para. 4.7: WITH ALL EQUIPMENT AND INSTRUMENTATION WORKING PROPERLY, DRAIN TANK, RELIEVE PRESSURE AND EVACUATE TANK.

ITEM	OPERATIONAL REMARKS
Vacuum Achieved (10 ± 1/2 PSI)	
Time to Achieve	
Time at Required Vacuum (3 Min.)	

NEGATIVE PRESSURE TEST INSPECTION

Ref. Para. 4.7.1: LEAK CHECK UNDER VACUUM

Close Vacuum Line and Inspect Vacuum Gauge for Vacuum Loss: _____

Inspect Tank for Leakage if Vacuum Loss: _____

POST PRESSURE TEST EXAMINATION

Ref. Para 4.8: RELIEVE VACUUM AND OPEN ACCESS PORTS

Visual Examination: _____

_____

_____

_____

Delaminations (Tap Test): _____

_____

_____

_____

EVALUATION OF DATA

POSITIVE PRESSURE TEST: _____

NEGATIVE PRESSURE TEST: _____

GENERAL CONDITION OF TANK: _____

DOCUMENT NUMBER

QTP-2191 SECTION "G"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR TANK FUEL CAPACITY

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 2/9/81

CHECKED BY: R. Sutton DATE: 2-11-81

APPROVED BY: C. A. Patmont Jr DATE: 2/12/81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "G"

DATE: 2/9/81

1.0 SCOPE

This procedure covers the requirements for Tank Fuel Capacity Testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-T-5624	Turbine fuel, aviation grade JP-4 and JP-5.
MIL-STD-831	Test reports, preparation of.

2.2 FEDERAL SPECIFICATION

P-D-680	Dry cleaning solvent.

2.3 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.4 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel tank.

3.0 REQUIREMENTS

3.1 TEST ARTICLE

Two (2) tank assemblies (2191-001) shall be securely fastened to a pylon (27-450-4400) which in turn is mounted to a functional test fixture by means of a simulated airframe adaptor. The tank shall then be fueled to a specified tank condition and subjected to the fuel capacity testing conditions of Technical Exhibit ASD/ENFEA-78, Paragraph 4.6.13.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 TEST FLUIDS

The recommended test fluid for this test shall be JP-5 per MIL-T-5624 or Stoddard Solvent per P-D-680. The actual density of the test fluid shall be established by sample test.

3.4 TEST METHOD

Each tank secured to the integral pylon shall be suspended in a 2^{0} nose down position from the functional test fixture by two (2) reaction load measuring devices similar to that shown in Figure 1. The actual tank capacity shall be verified by fuel weight to within 1/2 pound using the following test methods:

3.4.1 TOTAL TANK CAPACITY

Each completely empty and dry tank, pylon and all non-fuel carrying connecting hardware necessary for the test shall be weighed and recorded. The tank shall then be filled with the test fluid to its total capacity using special adaptors or venting devices to achieve a completely full tank condition. The totally full tank weight including fuel, pylon and non-fuel carrying hardware shall then be recorded, and the completely full tank capacity calculated.

3.4.2 TANK SUMP CAPACITY

Each completely full tank of Paragraph 3.4.1 shall be defueled through the fuel transfer tube using 15 ± 2 psi pressure applied through the vent line. The weight of the tank, pylon, non-fuel carrying hardware and the remaining fuel shall be recorded when the low level float switch is actuated and again when the actual fuel transfer is complete. The tank sump capacity and the usable fuel remaining in the tank when the float switch is actuated shall be calculated.

3.4.3 USEABLE FUEL CAPACITY

Each empty tank of Paragraph 3.4.2 shall then be filled at a rate of 50 ± 5 gallons per minute with 10 ± 2 psi pressure until the high level float switch is actuated. The weight of the tank, pylon, fuel and non fuel carrying test hardware shall be recorded at the high level float switch actuation. This test shall be repeated for overflow at the vent line and again for overflow at the fill cap with the fill cap removed.

3.5 TEST INSTRUMENTATION

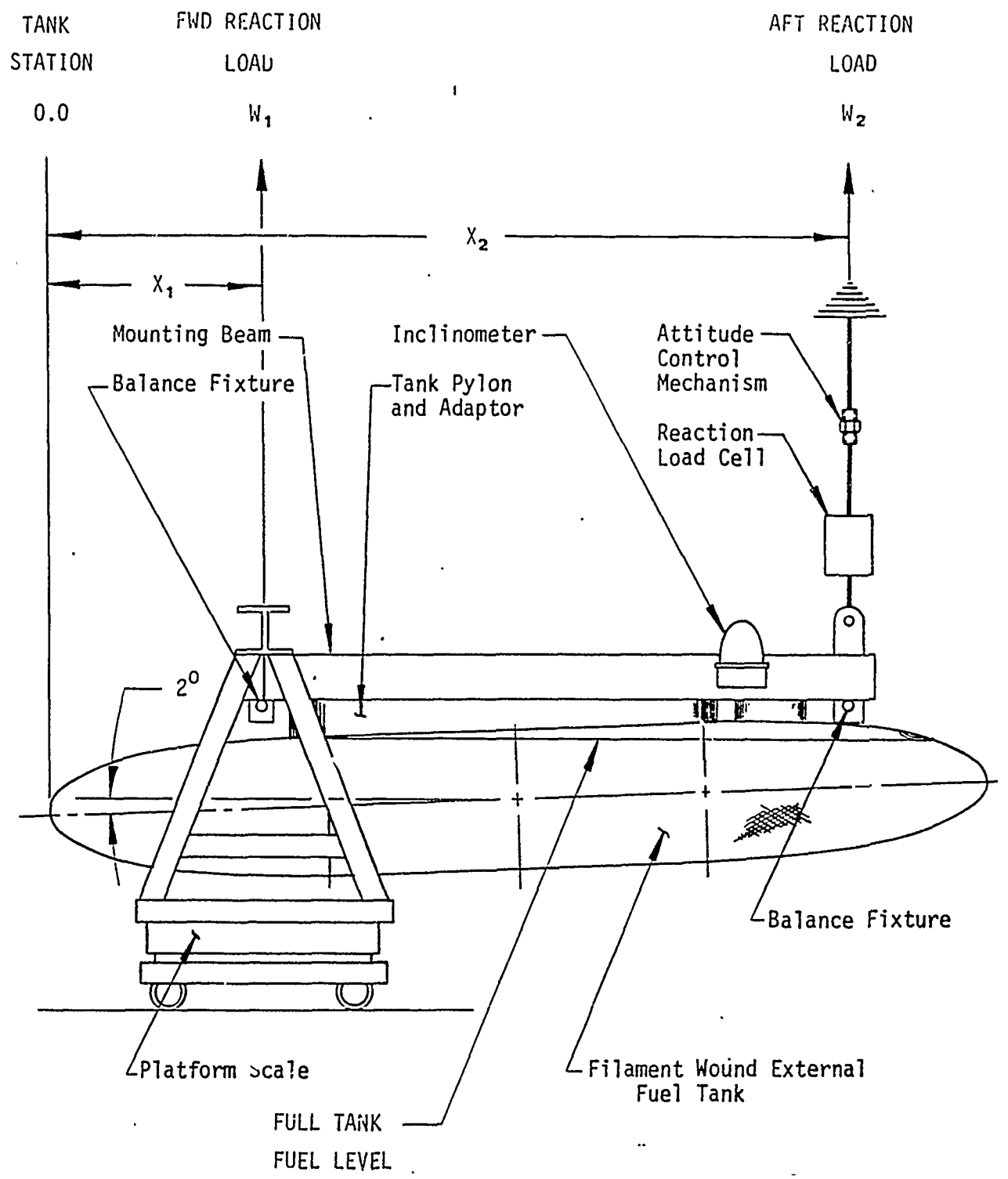
The instrumentation and test equipment used for this procedure shall be of good commercial quality and in proper working condition. Weighing devices used to measure fuel capacity shall be properly calibrated and capable of accurately reading the fuel and tank weights to within ½ pound over the full scale of the device.

3.5.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within ± 2% of its full scale value unless otherwise specified. No instrument shall be used that has not been calibrated within the previous calibration period.

3.6 DOCUMENTATION

At the conclusion of testing a test report will be prepared for submission to the contractor.



FUNCTIONAL TEST FIXTURE

FIGURE 1

TANK FUEL CAPACITY ARRANGEMENT

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

Each tank and pylon shall be fully examined prior to mounting to the test fixture for damage. This examination shall include a visual inspection and a tap test for delaminations if not accomplished as part of the final inspection from previous test. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

Each tank and pylon shall then be mounted to the test fixture in a 2^{0} nose down attitude by means of the simulated airframe adaptor and examined for proper attachment and assimilation to the actual aircraft installation. Install all fuel air and electrical connections for simulated opertaion. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure or shall be deemed to be in compliance with the applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and approved by an authorized Fiber Science Test Engineer and an authorized Government representative.

4.4 INSTRUMENTATION AND TEST EQUIPMENT

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All reaction load measuring devices, fuel and pressure transfer lines, flow meters, and pressure gages shall be installed so as to have little or no affect on the test other than to provide accurate weight measurements.

4.4.3 OPERATION

All test equipment shall be checked for proper operation. Any defects in equipment shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 PREPARATION FOR TEST

Examine each tank for the following conditions before performing the tank capacity test:

4.5.1 DRY TANK INSPECTION

Remove each access cover and inspect tank to verify that the tank is completely empty. If tank is not completely empty, remove all remaining fluid and secure access covers.

4.5.2 TEST FLUID DENSITY

Remove a representative sample of the test fluid to determine the fluid density either by use of a hydrometer or by accurately weighing a known volume of the test fluid. The density of the test fluid is its weight in pounds divided by the fluid volume in cubic inches.

4.5.3 VOID VOLUME VENT

A special adapter for venting all air from the tank when completely filled with test fluid shall be vented through one of the access doors.

4.5.4 EMPTY TANK WEIGHT

Each completely empty tank shall be secured to an integral pylon, mounted in the test fixture, with all non-fuel carrying connecting hardware properly tethered so as to have little or no affect on the test. Record the combined weight of tank, pylon and all non-fuel carrying connecting hardware.

4.6 TOTAL TANK CAPACITY TEST

With each tank properly weighed and mounted in the test fixture in a 2^{0} nose down position, open the fueling valve and completely fill tank. Vent all trapped air in the tank thru the void volume vent adapter of paragraph 4.5.3. When the tank is completely full, record the reaction loads and calculate the total volume in gallons. The total tank volume should be 463.2 to 477.3 gallons.

4.7 TANK SUMP CAPACITY TEST

Empty each tank thru the fuel transfer tube using air pressure at 15 ± 2 psi. Record total reaction loads at the low level float switch actuation and again at an empty tank condition. Calculate the float switch signal volume and the actual sump volume in gallons. The sump volume should be 1.25 gallons maximum.

4.8 USABLE FUEL CAPACITY TEST

Refill tank to the requirements of paragraph 3.4.3. Record the combined reaction loads for each of the three (3) conditions. Calculate the usable fuel volume and record in gallons for each of the three (3) conditions. The usable fuel volume should be 450 to 457 gallons.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded reaction load data sheets. Each test tank shall be retained for further testing before returning to Fiber Science, Inc.

APPENDIX "A"

TEST DATA SHEETS

TEST DATA SHEET

QTR-2191' SECTION "G"

Testing Activity_____ Activity Test Engr._____

Tank Serial No. _____ F.S.I. Test Engr. _____

Test Date _____ Government Rep. _____

EXAMINATION OF PRODUCT

Ref. Para. 4.1: Visual Inspection:_____

_____

_____

_____

_____

Delaminations (Tap Test):_____

_____

_____

_____

_____

MOUNTING

Ref. Para. 4.2: Aircraft Simulated Attachment

Deviations If Any:_____ _____

_____

_____

_____

_____

ARRANGEMENT

Ref. Para. 4.3: APPROVED TEST ARRANGEMENT (Ref. Figure 1 and ASD/ENFEA-78 TECHNICAL EXHIBIT

Testing Activity Approval

Approved By_____ Date_____

F.S.I. Test Engineer Approval

Approved By_____ Date_____

Government Approval

Approved By_____ Date_____

Minimum of two signatures required.

INSTRUMENTATION

Ref. Para. 4.4.1 CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
Reaction Load Devices	
Hydrometer (If Applicable)	
Weighing Scales (If Applicalbe)	
Flow Meter	
Pressure Gauges	
Other Instruments:	
1.	
2.	
3.	

Ref. Para. 4.4.2: CHECK PROPER INSTALLATION

ITEM	REMARKS
Tank	
Simulated Aircraft Adapter	
Load Reaction Devices	
Fuel Level Indicator (Float Switch)	
Pressure Gages	
Flow Meters	
Other Instruments:	
1. _____	
2. _____	
3. _____	
4. _____	

Ref. Para. 4.4.3: CHECK PROPER OPERATION

ITEM	REMARKS
Load Reaction Devices	
Fuel Level Indicator (Float Switch)	
Pressure Gauges	
Flow Meters	
Other Instruments:	
1. _____	
2. _____	
3. _____	
4. _____	

PREPARATION FOR TEST
DRY TANK INSPECTION

Ref. Para. 4.5.1 REMOVE ACCESS COVERS AND INSPECT TANK FOR FUEL

Remarks: _____

_____

_____

_____

Ref. Para 4.5.2 VERIFY DENSITY OF TEST FLUID

Pyrometer reading (If Applicable)

ITEM	REMARKS
Type of Test Fluid	
Quantity of Test Fluid	
Pyrometer Density	

Volume Weight Calculation (If Applicable)

ITEM	REMARKS
Type of Test Fluid	
Fluid Sample Container Volume	
Container Weight	
Weight of Container and Sample	
Calculated Sample Weight	
Calculated Density	

VOID VOLUME VENT

Ref. Para. 4.5.3 CONSTRUCT VOID VOLUME VENT ADAPTER

Remarks: _____

_____

_____

_____

_____

_____

Sketch Of Adapter Assembly:

EMPTY TANK WEIGHT

Ref. Para. 4.5.4 RECORD EMTPY TANK, PYLON AND NON-FUEL CARRYING HARDWARE WEIGHT

ITEM	REMARKS
Tank Shipping Weight	
Pylon Shipping Weight	
Non-Fuel Carrying Hardware	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
Empty Tank Reaction Load Weight:	
Fwd. Reaction Load	
Aft. Reaction Load	
Total Empty Weight	

TOTAL TANK CAPACITY

Ref. Para. 4.6 FUEL TANK TO A COMPLETELY FULL TANK CONDITION WITH VENT ADAPTER OPEN

ITEM	REMARKS
Test Fluid Density (Ref.Para.4.5.2)	
Empty Tank Weight (Ref.Para.4.5.4)	
Fueling Rate (50 GPM)	
Fueling Pressure (10 p.s.i.)	
Completely Full Reaction Loads:	
Fwd. Reaction Load	
Aft. Reaction Load	
Total Tank and Fluid Weight	
Calculated Total Fluid Weight	
Calculated Total Fluid Volume	

Remarks (Test Requirement 463.2 to 477.3 Gallons):

TANK SUMP CAPACITY

Ref. Para 4.7

DEFUEL TANK TO AN EMPTY TANK CONDITON THRU FUEL TRANSFER TUBE.

A. Low Level Float Switch Empty Signal

ITEM	REMARKS
Test Fluid Density (Ref.Para.4.5.2)	
Empty Tank weight (Ref.Para.4.5.4)	
Defueling Rate (50 GPM)	
Defueling Pressure (15 p.s.i.)	
Low Level Float Switch Actuation Reaction Loads:	
Fwd. Reaction Load	
Aft. Reaction Load	
Total Tank and Fluid Weight	
Calculated Sump Fluid Weight	
Calculated Sump Fluid Volume	

B. ACTUAL USABLE, FUEL EMPTY TANK CONDITION

ITEM	REMARKS
Test Fluid Density (Ref.Para.4.5.2)	
Empty Tank Weight(Ref.Para.4.5.4)	
Defueling Rate (50 GPM)	
Defueling Pressure (15 p.s.i.)	
Empty Tank Reaction Loads:	
Fwd. Reaction Load	
Aft. Reaction Load	
Total Tank and Fluid Weight	
Calculated Sump Fluid Weight	
Calculated Sump Fluid Volume	

Remarks (Test Requirement 1.25 gallons maximum at empty tank condition.):

TANK USABLE FUEL CAPACITY

Ref.Para. 4.8 REFUEL TANK TO AN OPERATIONAL FULL TANK CONDITION

A. HIGH LEVEL FLOAT SWITCH FULL

ITEM	REMARKS
Test Fluid Density(Ref.Para.4.5.2)	
Empty Tank Weight (Ref.Para.4.5.4)	
Fueling Rate (50 GPM)	
Fueling Pressure (10 psi)	
High Level Float Switch Actuation Reaction Loads:	
Fwd. Reaction Load	
Aft. Reaction Load	
Total Tank and Fluid Weight	
Calculated Usable Fluid Weight	
Calculated Usable Fluid Volume	

B. FILLER CAP OVERFLOW FULL

ITEM	REMARKS
Test Fluid Density (Ref.Para.4.5.2)	
Empty Tank Weight(Ref.Para.4.5.4)	
Fuel Overflow at Filler Cap Reaction Loads:	
Fwd. Reaction Load	
Aft. Reaction Load	
Total Tank and Fluid Weight	
Calculated Usable Fluid Weight	
Calculated Usable Fluid Volume	

Ref. Para. 4.8 C. VENT LINE OVERFLOW FULL

ITEM	REMARKS
Test Fluid Density(Ref.Para.4.5.2)	
Fuel Overflow at Air Vent:	
Fwd. Reaction Load	
Aft. Reaction Load	
Total Tank and Fluid Weight	
Calculated Usable Fluid Weight	
Calculated Usable Fluid Volume	

Remarks(Test Requirement 450 to 457 gallons of usable fuel)

EVALUATION OF DATA

TOTAL TANK CAPACITY:

TANK SUMP CAPACITY:

USABLE FUEL CAPACITY:

LOAD REACTION DEVICE:

DOCUMENT NUMBER

QTP-2191 SECTION "H"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR CENTER OF GRAVITY EXCURSION

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

RELEASED COPY
TO Dick Lyman DATE 4-1-81

PREPARED BY: Richard Lyman DATE: 2/10/81

CHECKED BY: Jim Crumbaker DATE: 2-13-81

APPROVED BY: C. A. Patrick Jr DATE: 2/13/81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "H"

DATE: 2/10/81 PAGE 1 OF 19

1.0 SCOPE

This procedure covers the requirements for center of gravity excursion testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-T-5624	Turbine Fuel, aviation grade JP-4 and JP-5.
MIL-STD-831	Test reports, preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound light-weight explosion proof.

2.3 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel tank.

3.0 REQUIREMENTS

3.1 TEST ARTICLE

One (1) tank assembly (2191-001) shall be securely fastened to a pylon (27-450-4400) which in turn is mounted to a functional test fixture by means of a simulated air frame adaptor. The tank shall then be fueled with a test fluid to a full tank condition and subjected to the center of gravity excursion test conditions of Paragraph 4.6.10 of the Technical Exhibit ASD/ENFEA-78.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter.

3.3 TEST FLUIDS

The recommended test fluid for this test shall be JP-5 per MIL-T-5624. The actual density of the test fluid shall be established by sample test.

3.4 TEST METHOD

A completely empty and dry tank shall be prepared for testing. A simulated airframe adaptor shall be mounted to the functional test fixture by two (2) reaction load measuring devices in such a way as to support the tank in a $2^{o} \pm 15'$ nose down position. The forward and aft reaction loads and their location relative to the pylon mounting hook locations shall be measured and recorded and the exact weight and center of gravity of the simulated airframe adaptor shall be calculated. The tank shall then be mounted to the simulated airframe adaptor, with no excess hardware attached to the tank that would not be present during normal usage on the H-53 Helicopter, and tested to the following conditions:

3.4.1 COMPLETELY EMPTY TANK CENTER OF GRAVITY

With the tank mounted to the simulated airframe adaptor in a $2^{o} \pm 15'$ nose down attitude, record the forward and aft reaction loads and calculate the exact weight and center of gravity of the empty and dry tank.

3.4.2 NORMAL FULL TANK CENTER OF GRAVITY

With the empty weight and center of gravity of the tank and pylon established, fuel the tank through the fuel transfer tube with JP-5 test fluid to a full tank condition (450 to 457 gallons) as determined by the float switch actuation. Record the forward and aft reaction loads and calculate the exact full tank weight and center of gravity.

3.4.3 CENTER OF GRAVITY EXCURSION

The 2^{0} nose down center of gravity excursion caused by fuel transfer from the tank shall be established. This shall be done by removing the test fluid in 25 gallon increments from the tank as accurately as possible, recording the forward and aft reaction loads at each fuel transfer increment and calculating the weight and center of gravity at each increment.

3.5 TEST INSTRUMENTATION

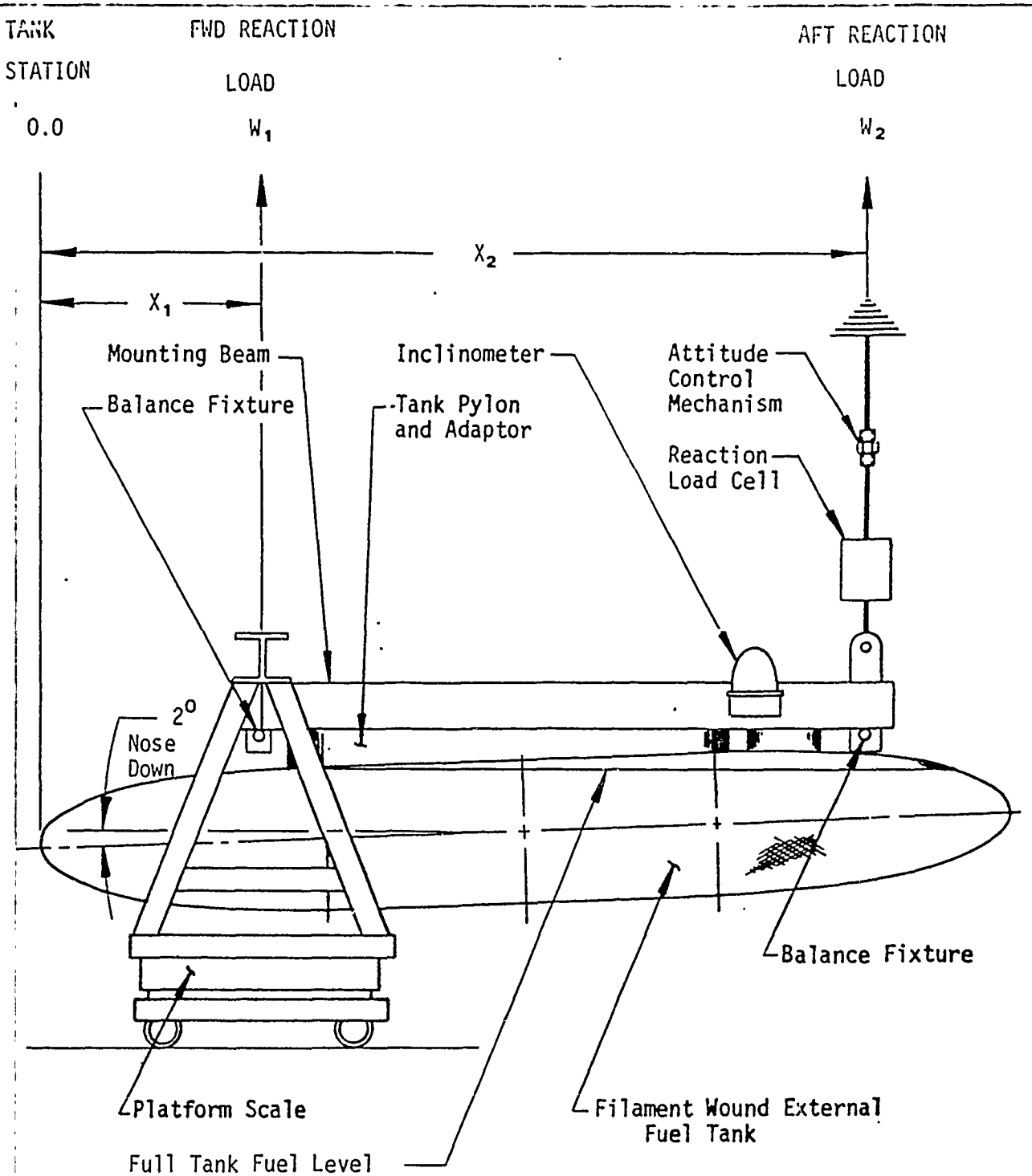
The instrumentation and test equipment used for this procedure shall be of good commercial quality and in proper working condition. Weighing devices used to measure the center of gravity excursion shall be properly calibrated and capable of accurately reading the fuel and tank weights to within 1/2 pound over the full scale of the device.

3.5.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be calibrated and capable of reading or recording data within $\pm$ 2% of its full scale value unless otherwise specified. No instrument shall be used that has not been calibrated within the previous calibration period.

3.6 DOCUMENTATION

At the conclusion of testing, a test report will be prepared for submission to the contractor.



FUNCTIONAL TEST FIXTURE

FIGURE 1

CENTER OF GRAVITY EXCURSION ARRANGEMENT

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

The tank and pylon shall be fully examined prior to mounting to the test fixture for damage. This examination shall include a visual inspection and a tap test for delaminations if not accomplished as part of the final inspection from previous test. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure or shall be deemed to be in compliance with the applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and approved by an authorized Fiber Science Test Engineer and an authorized Government representative.

4.3 INSTRUMENTATION AND TEST EQUIPMENT

4.3.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.3.2 INSTALLATION

All reaction load measuring devices, fuel and pressure transfer lines, flow meters, and pressure gauges shall be installed so as to have no affect on the test results other than to provide accurate weight measurements.

4.3.3 OPERATION

All test equipment shall be checked for proper operation. Any defects in equipment shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.4 PREPARATION FOR TEST

Examine the tank for the following conditions before performing the tank center of gravity excursion test:

4.4.1 DRY TANK INSPECTION

Remove each access cover and inspect tank to verify that the tank is completely empty. If tank is not completely empty, remove all remaining fluid and secure access covers.

4.4.2 TEST FLUID DENSITY

Remove a representative sample of the test fluid to determine the fluid density either by use of a hydrometer or by accurately weighing a known volume of the test fluid. The density of the test fluid is its weight in pounds divided by the fluid volume in cubic inches.

4.4.3 SIMULATED AIR FRAME ADAPTOR TARE WEIGHT

The simulated airframe adaptor shall be mounted to the reaction load measuring device of the functional test fixture to the requirements of Paragraph 3.4. The adaptor shall be examined for proper attachment and assimilation to the actual aircraft installation. Install all fuel, air and electrical connections for simulated operation. Any significant variations or deviations shall be recorded. Record the tare weight of the fwd and aft reaction loads and calculate the total adaptor weight and center of gravity.

4.5 CENTER OF GRAVITY TESTING

The tank secured to the pylon shall be mounted to the simulated airframe adaptor and tested to the following provisions:

4.5.1 EMPTY TANK CENTER OF GRAVITY TEST

Perform the empty tank center of gravity test to the requirements of Paragraph 3.4.1. Calculate the exact location of the empty tank center of gravity.

4.5.2 NORMAL FULL TANK CENTER OF GRAVITY TEST

Fuel tank to a normal full condition and perform the normal full tank center of gravity test to the requirements of Paragraph 3.4.2. Calculate the exact location of the normal full center of gravity.

4.5.3 CENTER OF GRAVITY EXCURSION

Perform the center of gravity excursion tests to the requirements of Paragraph 3.4.3. Calculate the exact location of each increment of the center of gravity excursion and plot the excursion.

5.0 QUALIFICATION TEST REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorded weight data sheets for calculating tank volume. The test tank shall be returned to Fiber Science for further testing in the same shipping container it was received in.

APPENDIX "A"

TEST DATA SHEETS

TEST DA A SHEET

QTR-2191 CTION "H"

Testing Activity _____ Activity Test Engr. _____

Tank Serial No. _____ F.S.I. Test Engr. _____

Test Date _____ Government Rep. _____

EXAMINATION OF PRODUCT

Ref. Para. 4.1: Visual Inspection: _____

_____

_____

_____

_____

Delaminations (Tap Test) _____

_____

_____

_____

_____

ARRANGEMENT

Ref. Para. 4.2: APPROVED TEST ARRANGEMENT (Ref. Figure 1 and ASD/ENFEA-78 TECHNICAL EXHIBIT

Testing Activity Approval

Approved By_____ Date_____

F.S.I. Test Engineer Approval

Approved By_____ Date_____

Government Approval

Approved By_____ Date_____

Minimum of two signatures required.

INSTRUMENTATION

Ref. Para. 4.3.1: CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
Reaction Load Devices	_____
Hydrometer (If Applicable)	_____
Inclinometer (If Applicable)	_____
Flow Meter	_____
Pressure Gauges	_____
Other Instruments:	
1._____	_____
2._____	_____
3._____	_____

Ref. Para. 4.3.2: CHECK PROPER INSTALLATION

ITEM	REMARKS
Tank	
Simulated Aircraft Adaptor	
Load Reaction Devices	
Fuel Level Indicator (Float Switch)	
Inclinometer	
Pressure Gauges	
Flow Meters	
Other Instruments:	
1._____	
2._____	
3._____	

Ref. Para. 4.3.3: CHECK PROPER OPERATION

ITEM	REMARKS
Load Reaction Devices	
Fuel Level Indicator (Float Switch)	
Inclinometer	
Pressure Gauges	
Flow Meters	
Other Instruments:	
1._____	
2._____	
3._____	

PREPARATION FOR TEST

DRY TANK INSPECTION

Ref. Para. 4.4.1: REMOVE ACCESS COVERS AND INSPECT TANK FOR FUEL

Remarks: _____

_____

_____

_____

Ref. Para. 4.4.2: VERIFY DENSITY OF TEST FLUID

Pyrometer Reading (If Applicable)

ITEM	REMARKS
Type of Test Fluid	_____
Quantity of Test Fluid	_____
Pyrometer Density	_____

Volume Weight Calculation (If Applicable)

ITEM	REMARKS
Type of Test Fluid	_____
Fluid Sample Container Volume	_____
Container Weight	_____
Weight of Container and Sample	_____
Calculated Sample Weight	_____
Calculated Density	_____

SIMULATED AIRFRAME ADAPTOR TARE WEIGHT

Ref. Para. 4.4.3: RECORD TARE WEIGHT REACTION LOADS AND CENTER OF GRAVITY

Description of Tare Weight: _____

_____

_____

TARE WEIGHT

ITEM	REMARKS
Fwd. Reaction Load	
Aft. Reaction Load	
Calculated Total Tare Weight	
Calculated Tare C. G.	

CENTER OF GRAVITY TEST

EMPTY TANK CENTER OF GRAVITY TEST

Ref. Para. 4.5.1: RECORD EMPTY TANK AND PYLON WEIGHT AND CENTER OF GRAVITY

ITEM	REMARKS
Tank Shipping Weight	
Pylon Shipping Weight	
Empty Tank Reaction Load Weight:	
Fwd. Reaction Load	
Aft. Reaction Load	
Calculated Total Empty Weight	
Calculated Empty Tank Center of Gravity	

NORMAL FULL TANK CENTER OF GRAVITY TEST

Ref. Para. 4.5.2: FUEL TANK TO A FULL TANK CONDITION THROUGH THE FUEL TRANSFER TUBE

ITEM	REMARKS
Test Fluid Density (Ref. Para. 4.4.2)	
Empty Tank Weight (Ref. Para. 4.5.1)	
Empty Tank Center of Gravity (Ref. Para. 4.5.1)	
Fueling Rate (50 GPM)	
Fueling Pressure (10 PSI)	
Completely Full Reaction Loads:	
Fwd. Reaction Load	
Aft. Reaction Load	
Calculated Total Tank and Fluid Weight	
Calculated Total Tank and Fluid Center of Gravity	
Calculated Total Fluid Weight	
Calculated Total Center of Gravity	

Remarks: _____

ENTER OF GRAVITY EXCURSION TEST

Ref. Para. 4.5.3: DEFUEL TANK THROUGH THE FUEL TRANSFER LINE IN 25 GALLON INCREMENTS

ITEM

Test Fluid Density
(Ref. Para. 4.4.2) _____

Empty Tank Weight
(Ref. Para. 4.5.1) _____

Empty Tank Center of Gravity
(Ref. Para. 4.5.1) _____

Defueling Rate (50 G.P.M.) _____

Fueling Pressure (10 PSI) _____

Reaction Load Locations Relative
To Tank Station Lines:

Fwd. Reaction Load Location
(X_1) _____

Aft. Reaction Load Location
(X_2) _____

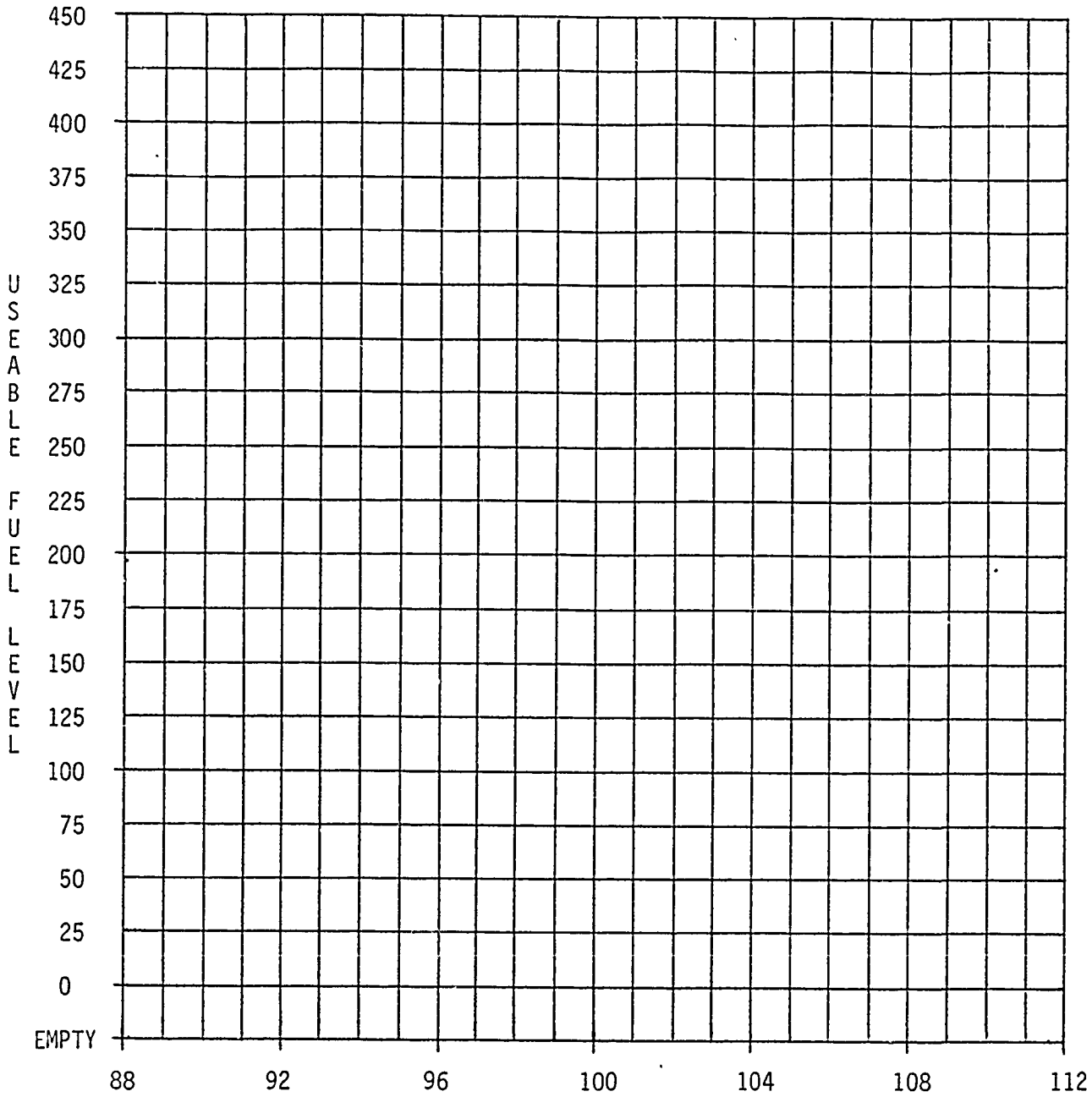
NOTE: Fwd reaction load W is the fwd reaction load reading minus the fwd reaction tare load.

Aft reaction load W is the aft reaction load reading minus the aft reaction tare load.

CENTER OF GRAVITY EXCURSION LOCATION

ITEM	USEABLE FUEL VOLUME V	FWD. REACTION LOAD W_1	AFT. REACTION LOAD W_2	TOTAL REACTION LOAD $W_1 + W_2$	FWD. REACTION MOMENT $W_1 X_1$	AFT. REACTION MOMENT $W_2 X_2$	CENTER OF GRAVITY LOCATION $\frac{W_1 X_1 + W_2 X_2}{W_1 + W_2}$
1	450						
2	425						
3	400						
4	375						
5	350						
6	325						
7	300						
8	275						
9	250						
10	225						
11	200						
12	175						
13	150						
14	125						
15	100						
16	75						
17	50						
18	25						
19	0						
20	EMPTY						

CENTER OF GRAVITY EXCURSION GRAPH



EVALUATION OF DATA

EMPTY TANK AND PYLON CENTER OF GRAVITY:

FULL TANK CENTER OF GRAVITY:

CENTER OF GRAVITY EXCURSION:

LOAD REACTION DEVICE:

DOCUMENT NUMBER

QTP-2191 SECTION "I"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR MAINTAINABILITY DEMONSTRATION

FOR SERIAL NUMBER _____

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 4/4/81

CHECKED BY: DATE:

APPROVED BY: C A Patunde Jr DATE: 4/17/81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "I"

DATE: 4/4/81

1.0 SCOPE

This procedure covers the requirements for maintainability demonstration of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-STD-831	Test Reports, Preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 Gallon External Fuel, Filament Wound Lightweight Explosion Proof.

2.3 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 Gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 Gallon Fuel Tank

2.4 QUALIFICATION TEST PROCEDURES

QTP-2191 SECTION "B"	Requirements For Product Examination.

3.0 REQUIREMENTS

3.1 TEST ARTICLES

Two (2) tank assemblies (2191-001) shall each be securely fastened to a pylon (27-450-4400) and placed on or secured to an assembly or maintenance fixture. The two tank units shall then be simultaneously subjected to the maintainability and interchangeability demonstration requirements of Paragraphs 3.4.3 and 3.12 of the Technical Exhibit ASD/ENFEA-78.

3.2 PREPARATION FOR TEST

3.2.1 EXAMINATION OF THE TEST ARTICLES

Each tank assembly shall be examined to verify that it is representative of a production article in completeness and workmanship and was fabricated in accordance with the approved manufacturing procedures.

3.2.2 ASSEMBLY DOCUMENTS

A complete set of documents covering the tank assembly and associated purchased parts shall be available.

3.2.3 TEST PERSONNEL

Two (2) mechanics or assembly technicians familiar with the tank assembly and two (2) or more test technicians shall be required to conduct the test and record data. A technical writer shall record the process as a rough draft for the tank overhaul manual.

3.2.4 EQUIPMENT FOR MAINTAINABILITY

Standard tools shall be provided by or for each mechanic or assembly technician.

3.3 TEST METHOD

The maintainability and interchangeability of each removable subassembly or part shall be demonstrated by the removal of all interchangeable subassemblies or parts from one tank assembly and reinstalling them in a second tank within eight (8) man-hours. A complete history of the time required to remove each individual subassembly or part and the time required to replace the same shall be recorded along with the

tools required to complete the task.

3.4 TEST EQUIPMENT

Two (2) stopwatches shall be used to record disassembly and assembly time of each interchangeable assembly or part. Torque wrenches and electrical meters or gauges used by mechanics or assembly technicians during the demonstration shall be of good commercial quality.

3.4.1 TEST EQUIPMENT CALIBRATION

All test equipment shall be calibrated and capable of reading or recording data within $\pm$ 2% of its full scale value. No test equipment shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

The test procedures shall be in accordance with Paragraph 4 of this document.

3.6 DOCUMENTATION

At the conclusion of the demonstration a technical report will be prepared for submission to the contractor.

4.0 QUALIFICATION TEST PROVISIONS

4.1 TEST EQUIPMENT

Two (2) stopwatches of good commercial quality shall be used to verify the disassembly and reassembly time of each interchangeable assembly or component of the tank. Any torque wrenches, electrical meters or gauges used in the maintainability demonstration shall be examined for proper working condition and ability to perform accurately the work required.

4.1.1 TEST EQUIPMENT CALIBRATION

The test equipment used to either monitor the maintainability demonstration or used as part of the maintainability demonstration shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.2 TEST PREPARATIONS

The following preparations shall be made prior to the actual maintainability demonstration test.

4.2.1 EXAMINATION OF TEST ARTICLES

Examine each tank assembly to verify that they were fabricated according to the Manufacturing Job Card and are in compliance with the latest revision of the Engineering drawings. It shall also be verified that each tank is thoroughly representative of future production tanks and that the pylon is fully assembled and fastened to the tank in a manner representative of a field-use condition.

4.2.2 ASSEMBLY DOCUMENTS

Verify that one complete set of documentation, that is, Engineering drawings and associated Parts List, wiring diagrams, special assembly instructions or specifications for purchased parts or assemblies and a preliminary outline for the Overhaul or Maintenance Manual is available.

4.2.3 TEST PERSONNEL

Sufficient test personnel shall be on hand to satisfy the requirements of Paragraph 3.2.3 as follows:

4.2.3.1 MECHANICS OR ASSEMBLY TECHNICIANS

Verify that the mechanics or assembly technicians who will be performing the maintainability demonstration are a) familiar with the assembly and disassembly process of the tank, b) of average ability, and c) have less than five (5) years experience as a mechanic.

4.2.3.2 TEST TECHNICIANS

Verify that a minimum of two test technicians are available with calibrated stopwatches and sufficient test data sheets (see Appendix A) to record the removal and reassembly time of each subassembly or part.

4.2.3.3 TECHNICAL WRITER

Verify that a technical writer with a preliminary outline of the demonstration procedure is available and ready to record the disassembly and assembly process.

4.2.4 MAINTAINABILITY EQUIPMENT

Verify that the tools and equipment to be used by the mechanics or assembly technicians are commonly found in any well supplied tool chest. All tools must be purchased at a well equipped tool supply store and be of common usage by mechanics or technicians involved in aircraft maintenance of fuel tanks.

4.3 MAINTAINABILITY DEMONSTRATION

The maintainability demonstration, which will also include by reason of the test an interchangeability demonstration of all subassemblies and parts removed and replaced, shall not exceed eight (8) man hours and shall be conducted as follows:

4.3.1 DISASSEMBLY

One (1) mechanic or assembly technician shall be assigned to each tank and pylon assembly. Each mechanic or assembly technician shall disassemble and remove from his assigned tank all required items. A test technician shall list all items removed from the tank, the tools required to remove the items, and the time required to accomplish the removal. Do not mix the parts removed from one tank with those removed from the other. The technical writer shall

record the various operations required to remove the parts as a rough draft for the Overhaul Manual. The replaceable and interchangeable items to be removed are as follows:

ITEM	PART NO.	QTY
Pylon Leading Edge Skin Assembly	27-450-4429	1
Pylon Trailing Edge Skin Assembly	27-450-4431	1
Pylon Structure Assembly	27-450-4399	1
Stub Pylon Assembly	2191-019	1
Fuel Shutoff Valve Assembly	2191-030	1
Air Shutoff Valve Assembly	2191-036	1
Tank Access Cap	2191-024	3
Tank Fill Cap	502-9	1
Tank Fuel Gauge Assembly	78-113-1099	1
Tank Fuel Gauge Harness Assembly	78-118-1099	1
Fuel Gauge Upper Attach Fitting	2191-042-3	1
Fuel Level Float Switch Assembly	FS-1533	1
Float Switch Tube Assembly		
Drain Valve Assembly	2191-068	1
Pylon Attach Lug	2191-048	4

4.3.2 REASSEMBLY

Each mechanic or assembly technician shall take the items that have been disassembled and rotate them to the opposite tank for reassembly. There shall be no mixing of parts. A test technician shall on the same data sheet used to record the item and its removal list the reassembly time and the tools required to accomplish the task.

4.4 INSPECTION

Upon completion of the reassembly per Paragraph 4.3.2 each tank shall be examined and inspected for compliance with the Engineering drawing, specifications and inspection criteria by the Quality Assurance Department. Any deviations shall be properly noted or corrected.

4.5 ACCEPTANCE TEST

Each tank after completion of maintainability demonstration shall receive an Acceptance Test to verify that the tank is leak tight and ready for further testing.

5.0 QUALIFICATION TEST REPORT

A formal Qualification Test Report shall be submitted per MIL-STD-831 within 30 days after the maintainability demonstration is complete. This report is to include copies of all demonstration test data sheets and the actual and average time to accomplish the task. Each test tank shall be prepared for shipment and further testing.

APPENDIX "A"

TEST DATA SHEETS

TEST DATA SHEET
QTP-2191 SECTION "I"

Testing Activity _____ Activity Test Engr. _____

Tank Serial No. _____ F.S.I. Test Engr. _____

Test Date _____ Government Rep. _____

TEST EQUIPMENT

Ref. Para. 4.1: CHECK PROPER OPERATION AND ACCURACY

ITEM	REMARKS
Stop Watch	_____
Torque Wrenches	_____
Electrical Meter	_____
Other Instruments:	
1. _____	_____
2. _____	_____

TEST EQUIPMENT CALIBRATION

Ref. Para. 4.1.1: CHECK EQUIPMENT CALIBRATION

ITEM	CALIBRATION DATE
Stop Watch	_____
Torque Wrenches	_____
Electrical Meter	_____
Other Instruments:	
1. _____	_____
2. _____	_____

PREPARATION FOR TEST

EXAMINATION OF TEST ARTICLE

Ref. Para. 4.2.1: VERIFY TANK ASSEMBLIES ARE REPRESENTATIVE OF PRODUCTION ARTICLES

Remarks: _____

_____

_____

_____

ASSEMBLY DOCUMENTS

Ref. Para. 4.2.2: VERIFY PRESENCE OF ALL ASSEMBLY DOCUMENTS

ITEM	REMARKS
Fiber Science Drawings	_____
Vendor Drawings	_____
Fiber Science Specifications	_____
Vendor Specifications	_____

TEST PERSONNEL

MECHANICS OR ASSEMBLY TECHNICIANS

Ref. Para. 4.3.2.1: CERTIFY QUALIFICATIONS

Name and age of each mechanic or assembly technician

#1 NAME _____ AGE _____

#2 NAME _____ AGE _____

#3 NAME _____ AGE _____

#4 NAME _____ AGE _____

Mechanic or assembly technician is familiar with the assembly and disassembly process of the test article.

Remarks:

#1 _____

#2 _____

#3 _____

#4 _____

Mechanic or assembly technician is of average ability and has less than five years experience.

#1 _____

#2 _____

#3 _____

#4 _____

TEST TECHNICIANS

Ref. Para. 4.2.3.2: LIST NAMES AND ASSIGNMENT

	NAME	ASSIGNMENT
#1	_____	_____
#2	_____	_____
#3	_____	_____
#4	_____	_____

TECHNICAL WRITER

Ref. Para 4.2.3.3: LIST NAME AND FILE OUTLINE WITH THIS REPORT

NAME

_____

OUTLINE FILED

REMARKS: _____

_____

MAINTAINABILITY EQUIPMENT

Ref. Para 4.2.4: VERIFY TOOLS ARE COMMONLY FOUND IN WELL SUPPLIED TOOL CHEST

TOOL LIST

1. _____	17. _____	33. _____
2. _____	18. _____	34. _____
3. _____	19. _____	35. _____
4. _____	20. _____	36. _____
5. _____	21. _____	37. _____
6. _____	22. _____	38. _____
7. _____	23. _____	39. _____
8. _____	24. _____	40. _____
9. _____	25. _____	41. _____
10. _____	26. _____	42. _____
11. _____	27. _____	43. _____
12. _____	28. _____	44. _____
13. _____	29. _____	45. _____
14. _____	30. _____	46. _____
15. _____	31. _____	47. _____
16. _____	32. _____	48. _____

MAINTAINABILITY DEMONSTRATION

DISASSEMBLY

Ref. Para. 4.3.1: APPROVED TEST ARRANGEMENT

TESTING ACTIVITY APPROVAL

APPROVED BY _____ DATE _____

F.S.I. TEST ENGINEER APPROVAL

APPROVED BY _____ DATE _____

GOVERNMENT APPROVAL

APPROVED BY _____ DATE _____

MINIMUM OF TWO SIGNATURES REQUIRED

RECORD OF ACTUAL DISASSEMBLY OF EACH SUBASSEMBLY OR PART AND THE TIME REQUIRED TO ACCOMPLISH EACH (SEE PAGES 15 THRU 29).

REASSEMBLY

Ref. Para. 4.3.2: APPROVED TEST MANAGEMENT

TESTING ACTIVITY APPROVAL

APPROVED BY _____ DATE _____

F.S.I. TEST ENGINEER APPROVAL

APPROVED BY _____ DATE _____

GOVERNMENT APPROVAL

APPROVED BY _____ DATE _____

MINIMUM OF TWO SIGNATURES REQUIRED

RECORD OF ACTUAL REASSEMBLY OF EACH SUBASSEMBLY OR PART AND THE TIME REQUIRED TO ACCOMPLISH EACH (SEE PAGES 15 THRU 29).

DISASSEMBLY

Ref. Para. 4.3.1: PYLON LEADING EDGE SKIN ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: PYLON LEADING EDGE SKIN ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: PYLON TRAILING EDGE SKIN ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: PYLON TRAILING EDGE SKIN ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: PYLON STRUCTURE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: PYLON STRUCTURE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: STUB PYLON ASSEMBLY

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: STUB PYLON ASSEMBLY

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: FUEL SHUTOFF VALVE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: FUEL SHUTOFF VALVE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: AIR SHUTOFF VALVE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: AIR SHUTOFF VALVE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: TANK ACCESS CAP

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: TANK ACCESS CAP

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: TANK FILL CAP

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: TANK FILL CAP

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: TANK FUEL GAUGE ASSEMBLY

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: TANK FUEL GAUGE ASSEMBLY

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: TANK FUEL GAUGE HARNESS ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: TANK FUEL GAUGE HARNESS ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: FUEL GAUGE UPPER ATTACH FITTING

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: FUEL GAUGE UPPER ATTACH FITTING

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: FUEL LEVEL FLOAT SWITCH ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: FUEL LEVEL FLOAT SWITCH ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: FLOAT SWITCH TUBE ASSEMBLY

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: FLOAT SWITCH TUBE ASSEMBLY

ITEMS

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: DRAIN VALVE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: DRAIN VALVE ASSEMBLY

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

DISASSEMBLY

Ref. Para. 4.3.1: PYLON ATTACH LUG

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

DISASSEMBLY TIME REQUIRED _____

REASSEMBLY

Ref. Para. 4.3.2: PYLON ATTACH LUG

ITEMS

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

REMARKS: _____

_____

_____

REASSEMBLY TIME REQUIRED _____

INSPECTION

Ref. Para. 4.4: INSPECT TANK AND PYLON FOR COMPLETENESS OF ASSEMBLY

TANK PER 2191-001

REMARKS: _____

_____

_____

QUALITY ASSURANCE APPROVAL _____

PYLON PER 27-450-4400

REMARKS: _____

_____

_____

QUALITY ASSURANCE APPROVAL _____

ACCEPTANCE TEST

Ref. Para. 4.5: APPROVED ACCEPTANCE TEST

Q.A. REP. _____ TEST DATE _____

REMARKS: _____

_____

_____

_____

_____

_____

QUALITY ASSURANCE APPROVAL _____

EVALUATION OF DATA

DISASSEMBLY DEMONSTRATION: _____

_____

_____

_____

_____

REASSEMBLY DEMONSTRATION: _____

_____

_____

_____

_____

TIME REQUIRED FOR DEMONSTRATION

ITEM		ACTUAL TIME	AVERAGE TIME
DISASSEMBLY:			
SERIAL NUMBER	_____	_____	_____
SERIAL NUMBER	_____	_____	
REASSEMBLY:			
SERIAL NUMBER	_____	_____	_____
SERIAL NUMBER	_____	_____	
TOTAL DEMONSTRATION			
SERIAL NUMBER	_____	_____	_____
SERIAL NUMBER	_____	_____	

INSPECTION AND ACCEPTANCE TEST: _____

_____

DOCUMENT NUMBER

QTP-2191 SECTION "J"

TITLE

QUALIFICATION TEST PROCEDURE

H-53 TANK

REQUIREMENTS FOR SLOSH AND VIBRATION TEST

REVISIONS

LTR.	DATE	PREPARED	APPROVED	DESCRIPTION

PREPARED BY: Richard Lyman DATE: 1/14/81

CHECKED BY: Randy Stone DATE: 1-27-81

APPROVED BY: C. A. Pattrode Jr DATE: 1/28/81

FIBER SCIENCE, INC.
SALT LAKE CITY, UTAH

NO. QTP-2191 Section "J"

DATE: 1/14/81

1.0 SCOPE

This procedure covers the requirements for Slosh and Vibration testing of the 450 Gallon Filament Wound External Fuel Tank for the H-53 Helicopter.

2.0 APPLICABLE DOCUMENTS

2.1 MILITARY SPECIFICATIONS

MIL-T-7378	Tanks, Removable Auxiliary External Aircraft Fuel
MIL-STD-831	Test Reports, Preparation of.

2.2 TECHNICAL EXHIBIT

ASD/ENFEA-78	Tank - 450 gallon external fuel, filament wound lightweight explosion proof.

2.3 DRAWINGS

FIBER SCIENCE

2191-001	Tank - Installation, 450 gallon H-53

SARGENT FLETCHER

27-450-4400	Pylon Assembly - 450 gallon fuel tank.

3.0 REQUIREMENTS

3.1 TEST ARTICLES

Two (2) tank assemblies 2191-001 each equipped with an integral pylon (27-450-4400) shall be mounted to an adaptor which in turn shall be mounted to a slosh and vibration test fixture and subjected individually to the test requirements as described in Technical Exhibit ASD/ ENFEA-78, Paragraph 4.6.14 and those applicable paragraphs of MIL-T-7378.

3.2 TEST ARRANGEMENT

The test arrangement shall be similar to that shown in Figure 1 with all reasonable precautions taken to simulate the actual mounting of the tank and pylon to the helicopter. The tank centerline shall be at least 20 inches above the slosh axis.

3.3 TEST METHOD

Each test tank shall be suspended in a 2^{o} nose down position from the integral pylon when mounted to a support adaptor fastened to the slosh and vibration fixture when the slosh and vibration fixture is positioned in the level or horizontal position. The following test conditions apply:

3.3.1 TEST FIXTURE

The slosh and vibration test fixture shall have the capability of performing the slosh and vibration requirements described in this procedure and have a minimum rocking angle of $\pm 15^{o}$ from the level or horizontal position and a minimum double amplitude vibration of .020 inches at the mounting bolts of the test article.

3.3.2 VIBRATION DISPLACEMENT

The average displacement during testing between the top and bottom of each tank at the supporting bulkheads shall be a minimum of .032 inches.

3.3.3 VIBRATION FREQUENCY

The vibration frequency for testing the tank shall be 1940 to 2000 cycles per minute

3.3.4 MOUNTING AXIS

Each tank shall be mounted in a manner such that the longitudinal axis of the tank is 90^{0} to the centerline of the axis of the shaft of the rocker assembly platform. For the pitch portion of the test see Figure 1. For the roll portion of the test, the longitudinal axis of each tank shall be above but in line with the centerline of the axis of the shaft of the rocker arm assembly platform. (See Figure 1).

3.3.5 TEST FLUID

Each test tank shall be filled two thirds (2/3) full with water at ambient temperature for the primary portion of the slosh and vibration test.

3.3.6 TEST PRESSURE

The test pressure inside the tank during the slosh and vibration test shall be the normal operating pressure of the tank when used on the aircraft. The normal operating pressure of the H-53 fuel system is 15 psi.

3.3.7 PRIMARY TEST SEQUENCE

Each tank shall be simultaneously sloshed and vibrated in a pitch condition for twelve and one-half (12-1/2) hours. Each tank shall then be oriented for the roll condition and sloshed and vibrated for an additional twelve and one-half (12-1/2) hours. This test shall be accomplished at the vibration displacement level of Paragraph 3.3.2 and the vibration frequency level of Paragraph 3.3.3.

3.3.8 VIBRATION TEST SEQUENCE

Following the primary slosh and vibration test of Paragraph 3.3.7, each tank shall be rotated back to the position it was in for the pitch portion of the test, filled to the full fuel level with water, and vibrated only, for a period of ten (10) minutes. The vibration displacement and frequency shall be per Paragraph 3.3.2 and 3.3.3 respectively.

3.3.9 POST VIBRATION EXAMINATION

Each tank upon completion of the slosh and vibration test shall be examined for evidence of leakage, failure or excessive wear.

3.3.10 POST VIBRATION PRESSURE TEST

Each tank shall be subject to the following pressure tests after completion of the slosh and vibration tests:

a. 112 psi positive pressure for 3 minutes.

b. 05 psi negative pressure for 3 minutes.

c. 25 psi positive pressure for 15 minutes.

3.4 TEST INSTRUMENTATION

A 16 MM full color movie shall be taken of each aspect of the test. An accelerometer shall be attached to each end of the pylon at the pylon attach points to verify proper vibration. Ten (10) biaxial strain gauges shall be located on the tank to record at periodic intervals the working stress upon the tank structure. During and after the test, 12 color still photos shall be taken to document the test and any damage to the test articles.

3.4.1 INSTRUMENTATION CALIBRATION

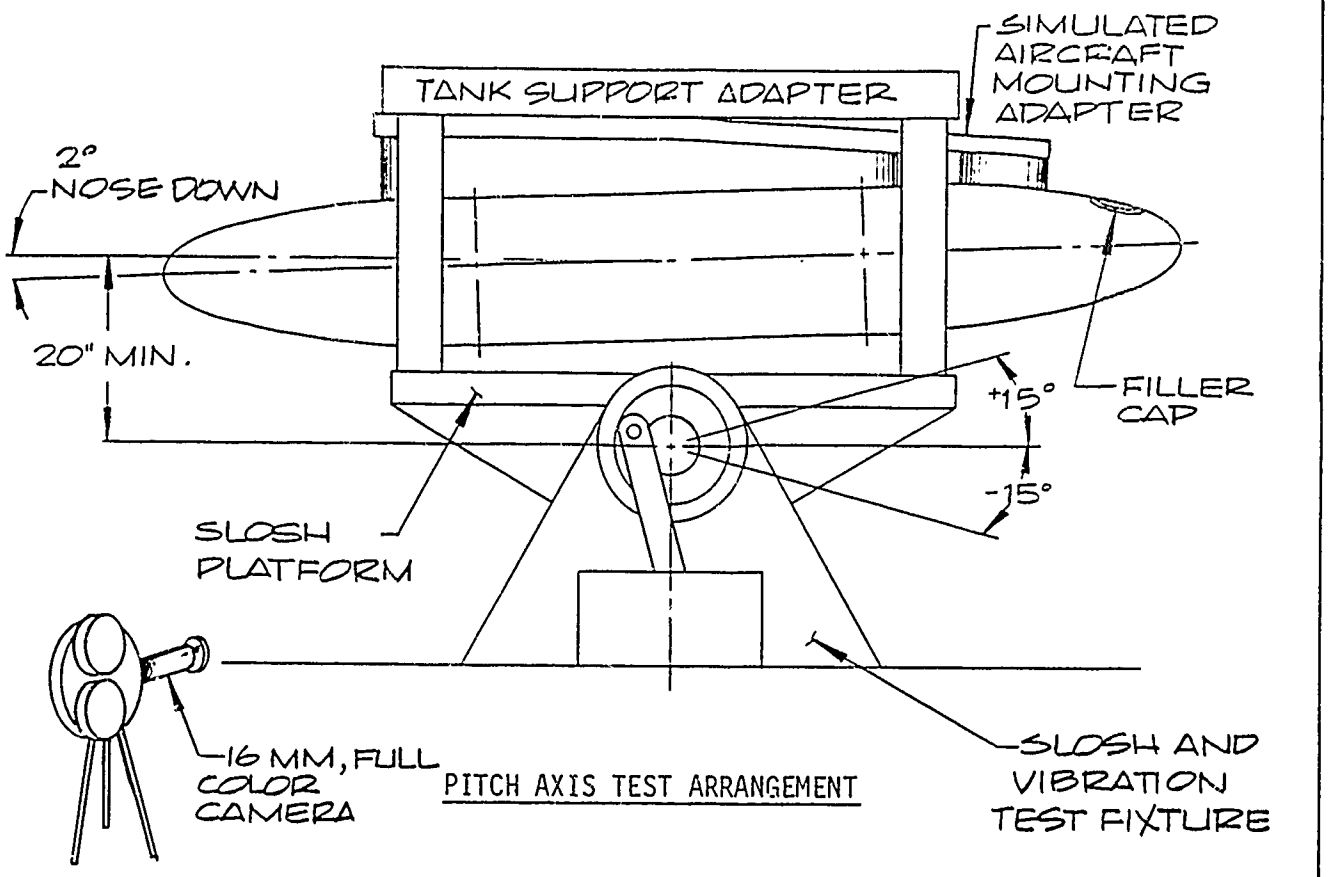
All instrumentation shall be calibrated and capable of reading or recording data within ± 2% of its full scale value. No instrument shall be used that has not been calibrated within the previous calibration period.

3.5 TEST PROCEDURES

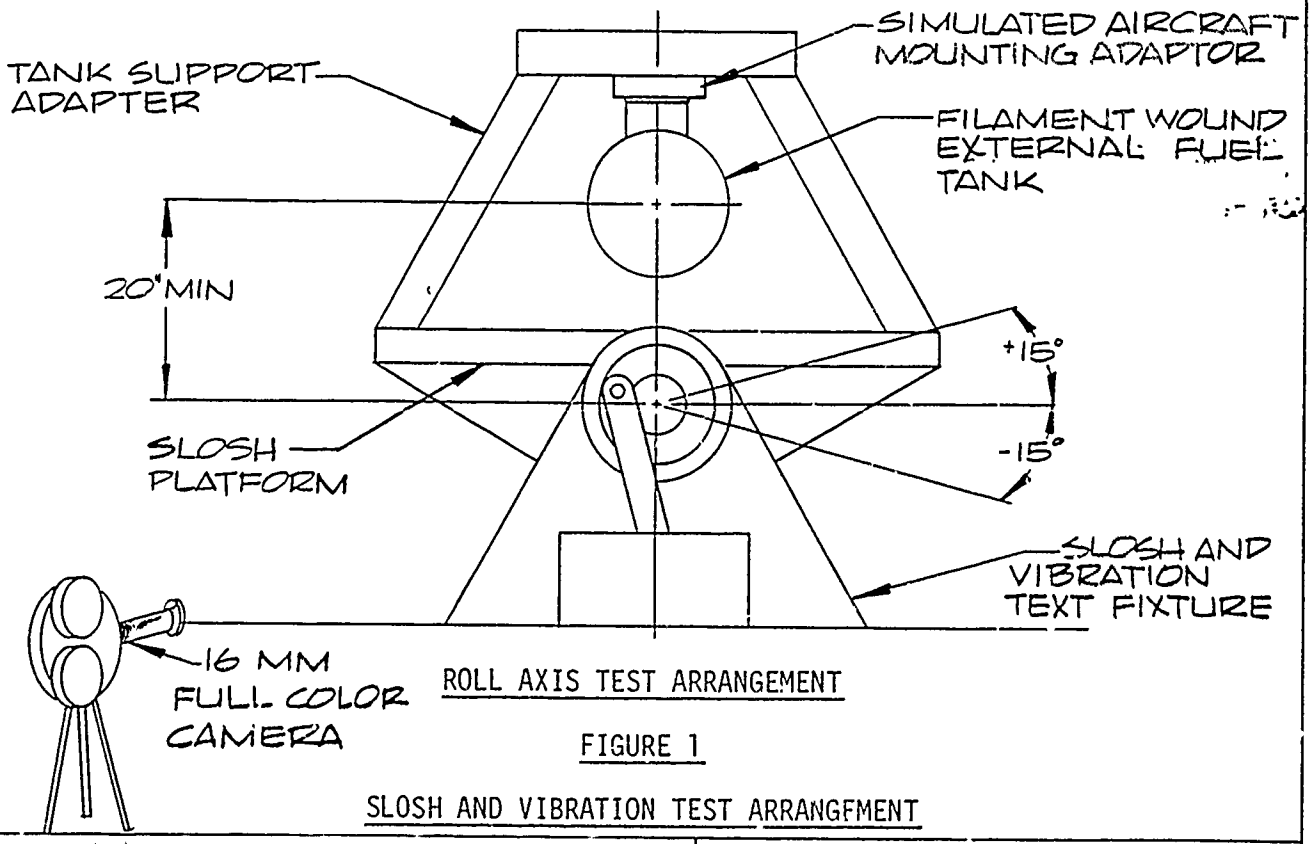
The test procedures shall be in accordance with Paragraph 4 of this document.

3.6 DOCUMENTATION

At the conclusion of testing a test report shall be prepared for submission to the contractor.



PITCH AXIS TEST ARRANGEMENT



ROLL AXIS TEST ARRANGEMENT

FIGURE 1

SLOSH AND VIBRATION TEST ARRANGEMENT

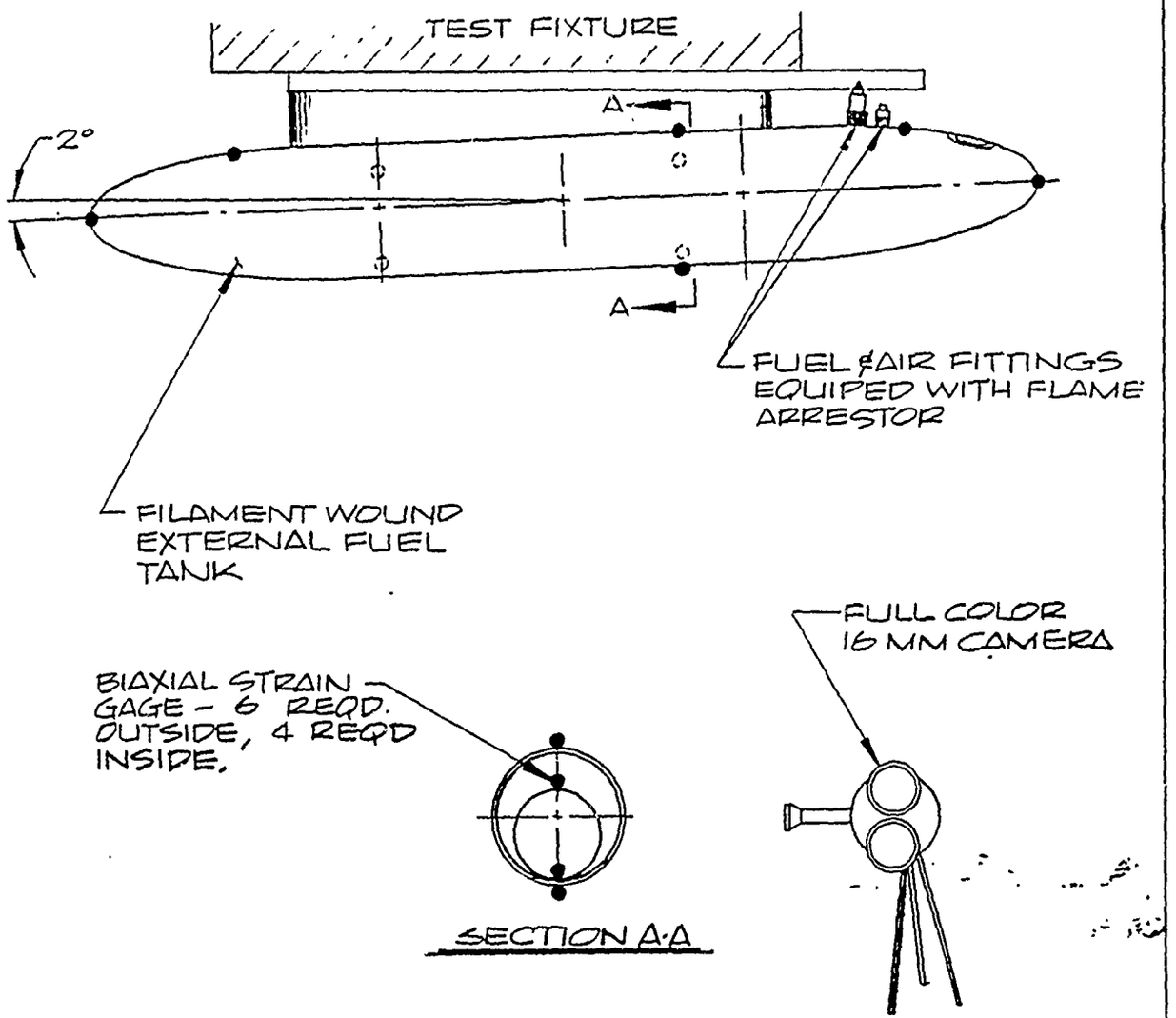


FIGURE 2

STRAIN SENSOR ARRANGEMENT

4.0 QUALIFICATION TEST PROVISIONS

4.1 EXAMINATION OF PRODUCT

Each tank and pylon shall be fully examined prior to mounting to the test fixture for shipping damage to the test site. This examination shall include a visual inspection and a tap test for delaminations. The results of this inspection shall be recorded by the testing activity in the presence of an authorized Fiber Science Test Engineer.

4.2 MOUNTING

Each tank and pylon shall then be mounted to the test fixture to the requirements of Paragraph 3.3 and examined for proper attachment and assimilation to the actual aircraft installation. Any significant variations or deviations shall be recorded.

4.3 ARRANGEMENT

The test arrangement shall be examined for compliance with Figure 1 of this procedure and applicable paragraphs of ASD/ENFEA-78 Technical Exhibit and MIL-T-7378.

4.4 INSTRUMENTATION AND TEST EQUIPMENT

4.4.1 INSTRUMENTATION CALIBRATION

All instrumentation shall be inspected to verify that each instrument has had a calibration check within the last calibration period.

4.4.2 INSTALLATION

All instruments and test equipment: slosh and vibration test fixture, camera, biaxial strain gauges, pressure gauges, accelerometers, and recorders shall be installed in such a way as to best satisfy the intent of the test. Biaxial strain gauge readings shall be taken at locations indicated in Figure 2 of this procedure.

4.4.3 OPERATION

All instrumentation and test equipment shall be checked for proper operation. Verify that the slosh and vibration test fixture meets the requirements of Paragraph 3.3.1 through Paragraph 3.3.4. Any defects in instrumentation shall be recorded and the test shall not proceed until the defect is removed or deemed not critical for the test required by the testing activity and approved by an authorized Fiber Science Test Engineer.

4.5 SLOSH AND VIBRATION TEST

4.5.1 FUELING AND PRESSURIZATION

With the tank mounted about the pitch axis in a 2^{0} nose down position, remove the filler cap and fill the tank with 300 to 305 gallons (2/3 full) of water at ambient temperature. Secure filler cap and pressurize tank to 15 psi ± 2 psi in preparation for test.

4.5.2 PITCH AXIS TEST

Slosh and vibrate the test tank about the pitch axis for twelve and one-half (12-1/2) hours. There shall be no leakage or failure during the test. Drain tank then rotate 90^{0} to the roll axis and secure to the test fixture.

4.5.3 ROLL AXIS TEST

Refuel and pressurize tank to the requirements of Paragraph 4.5.1. Slosh and vibrate the test tank about the roll axis for twelve and one-half (12-1/2) hours. There shall be no leakage or failure during the test. Drain tank then rotate 90^{0} back to the pitch axis and secure to the test fixture.

4.5.4 VIBRATION TEST

Refuel the test tank to a full tank condition (450 to 457 gallons) and pressurize to the requirements of Paragraph 4.5.1. The test tank shall then be vibrated for 10 minutes. There shall be no leakage or failure during the test.

4.6 POST VIBRATION EXAMINATION

The tank shall be emptied and examined for evidence of leakage, failed parts, excessive wear of the tank or undue looseness or wear of the pylon.

4.7 POST VIBRATION PRESSURE TEST

Following the vibration test and examination of Paragraph 4.5.4 and 4.6, refill the tank with water (450 to 457 gallons) and perform the following tests:

a. Pressurize to 112 psi for three (3) minutes. There shall be no failure or evidence of leakage.

b. Drain tank and vacuum test to 05 psi (10,2 inches of Hg.) for 3 minutes.. There shall be no failure or evidence of leakage.

c. Refill tank with water (450 to 457 gallons) and pressurize to 25 psi for 15 minutes. There shall be no failure or evidence of leakage.

4.8 POST SLOSH AND VIBRATION EXAMINATION

Visually inspect and tap test entire surface of tank for delaminations. Record all external damage if any to the outside surface of tank. Remove both access openings and filler cap and visually inspect the interior of the tank. Record all internal damage to the tank shell, frames, baffles, fittings or tubing. Photograph all internal and external damage if any. Identify photographs by number and location.

5.0 QUALIFICATION REPORT

A formal qualification test report shall be submitted per MIL-STD-831 within 30 days after the testing is complete. This report is to include all recorder strain data sheets, 16 MM film and photographs. The test tank shall be returned to Fiber Science for further testing in the same shipping container it was received in.

APPENDIX "A"

TEST DATA SHEETS

TEST DATA SHEET

QTR-2191 SECTION "J"

Testing Activity _____ Activity Test Engr. _____

Tank Serial No. _____ F.S.I. Test Engr. _____

Test Date _____ Government Rep. _____

EXAMINATION OF PRODUCT

Ref. Para. 4.1: Visual Inspection _____

Delaminations (Tap Test) _____

MOUNTING

Ref. Para. 4.2: Aircraft Simulated Attachment

Deviations If Any _____

ARRANGEMENT

Ref. Para. 4.3: Approved Test Arrangement (Ref. Figure 1, Figure 2, & ASD/ENFEA-78 Technical Exhibit.)

Testing Activity Approval

Approved By _____ Date _____

F.S.I. Test Engineer Approval

Approved By _____ Date _____

Government Approval

Approved By _____ Date _____

Minimum of two signatures required.

INSTRUMENTATION

Ref. Para. 4.4.1: CHECK INSTRUMENTATION CALIBRATION

ITEM	CALIBRATION DATE
Slosh and Vibration Mechanism (If Applicable)	
Cameras (If Applicable)	
Accelerometer	
Strain Gauge Recorder	
Timing Devices	
Pressure Gauge	
Other Instruments:	
1. _____	
2. _____	
3. _____	

Ref. Para 4.4.2 CHECK PROPER INSTALLATION

ITEM	REMARKS
Tank Mounting (Pitch or Roll)	
Cameras	
Accelerometers	
Strain Gauges	
Pressure Gauges	
Recorders	
Other Instruments	
1. _____	
2. _____	

Ref. Para. 4.4.3: CHECK PROPER OPERATION

ITEM	REMARKS
Slosh and Vibration Mechanism	
a. Pitch Angle	
b. Vibration Amplitude	
c. Vibration Displacement	
d. Vibration Frequency	
Cameras	
Accelerometer	
Strain Gauges	
Recorders	
Pressure Gauge	
Other Instruments:	
1. _____	

FUELING AND PRESSURIZATION

Ref. Para. 4.5.1: FUEL TANK AT PROPER ATTITUDE THEN PRESSURIZE

ITEM	REMARKS
Attitude (2° nose down)	
Fill with 300 to 305 gal.water	
Secure Filler Cap	
Pressurize to 15 psi	

PITCH AXIS TEST

Ref. Para. 4.5.2: SLOSH AND VIBRATE TANK ABOUT THE PITCH AXIS WITH ALL INSTRUMENTATION SYNCHRONIZED

ITEM	OPERATION REMARKS
Elapsed Time	
Pitch Angle	
Vibration Amplitude	
Vibration Displacement	
Vibration Frequency	
Strain Gauge Recorder	
Accelerometer Recorder	
Pressure Reading	
Other Instruments:	
1. _____	
2. _____	
Empty Tank and Examine	

Remarks: _____

_____

ROLL AXIS TEST

Ref. Para. 4.5.3: REFUEL AND SLOSH AND VIBRATE TANK ABOUT THE ROLL AXIS

Refuel tank at proper attitude then pressurize.

ITEM	REMARKS
Attitude (2^{o} Nose Down)	
Fill with 300 to 305 gal. water	
Secure Filler Cap	
Pressurize to 15 psi	

SLOSH AND VIBRATE WITH ALL INSTRUMENTATION SYNCHRONIZED.

ITEM	OPERATION REMARKS
Elapsed Time	
Roll Angle	
Vibration Amplitude	
Vibration Displacement	
Vibration Frequency	
Strain Gauge Recorder	
Accelerometer Recorder	
Pressure Reading	
Other Instruments:	
1. _____	
2. _____	

Empty Tank and Examine

Remarks: _____

VIBRATION TEST

Ref. Para. 4.5.4: REFUEL AND VIBRATE TANK ABOUT THE PITCH AXIS

Refuel Tank at Proper Attitude then Pressurize

ITEM	REMARKS
Attitude (2^0 Nose Down)	
Fill with 450 to 475 gal.water	
Secure Filler Cap	
Pressurize to 15 psi	

Vibrate Tank with all Instrumentation Synchronized

ITEM	OPERATION REMARKS
Elapsed Time	
Vibration Amplitude at Mounting Bolts	
Vibration Displacement at Support Bulkheads	
Strain Gauge Recorder	
Accelerometer Recorder	
Pressure Reading	
Other Instruments:	
1.	
2.	
3.	
4.	

POST VIBRATION EXAMINATION

Ref. Para. 4.6: EXAMINE TANK CONDITION

External Condition _____

_____

_____

_____

_____

Internal Condition _____

_____

_____

_____

_____

Pylon Condition _____

_____

_____

_____

_____

POST VIBRATION PRESSURE TEST

Ref. Para. 4.7: REFUEL AND PRESSURIZE TANK

Refuel Tank at Proper Attitude, then Pressurize

ITEM	REMARKS
Attitude (2° Nose Down)	
Fill with 450 to 457 Gal. Water	
Secure Filler Cap	
Pressurize to 112 psi for 3 Min.	

Defuel Tank and Vacuum Test

ITEM	REMARKS
Attitude (2° Nose Down)	
Empty Tank	
Secure Filler Cap	
Vacuum Test to 05 psi (10.2 inches Hg.) For 3 min.	

Refuel Tank at Proper Attitude then Pressurize

ITEM	REMARKS
Attitude (2° Nose Down)	
Fill with 450 to 457 gal.water	
Secure Filler Cap	
Pressurize to 25 psi for 15 minutes	

Empty Tank and Examine

Remarks: _____

_____

_____

_____

_____

POST SLOSH AND VIBRATION

Ref. Para. 4.8: EXAMINE TANK FOR THE FOLLOWING:

External Damage _____

Internal Damage _____

Pylon Damage _____

Delaminations (Tap Test) _____

Ref. Para. 4.8: COLOR PHOTOGRAPHS

PHOTO NUMBER	LOCATION
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Ref. Para. 4.8: COLOR PHOTOGRAPHS

PHOTO NUMBER	LOCATION
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	